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Aerospace Education in the Sixth Grade

Edith Marie Jackson
Central Washington University

AEROSPACE EDUCATION
IN THE SIXTH GRADE

A Thesis

Presented to

the Graduate Faculty

Central Washington College of Education

In Partial Fulfillment

of the Requirements for the Degree

Master of Education

by

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CHAPTER I

THE PROBLEM AND DEFINITIONS OF TERMS USED

Initial efforts of far-sighted educators, in their efforts to help the schools of America adjust themselves to the technological and cultural needs of the air age, in the past were focused on the science of aeronautics for the upper grades in the secondary schools. This emphasis was due largely to emergency war needs of the armed services in the early years of World War II. Emphasis has been shifted more recently to the infusion of aerospace subject matter and the implications thereof into existing courses in the elementary as well as in the secondary schools.

I. THE PROBLEM

Statement of the problem. Educators may better meet the broad objectives of a child's education, including a better understanding of the complex world in which he lives, his rights and corresponding responsibilities therein, improved attitudes, and strengthened skills, by the acceptance and use of study units which are of great interest to the child as a frame of reference.

Although airplanes, rockets, missiles, and space vehicles are a common interest to all children, especially

boys, many teachers are not yet prepared to handle an aerospace integration program in the elementary schools. Likewise, there is not enough readily available information and material to successfully handle such a program, and preparation of subject matter for an aerospace program may be more difficult or require too much extra time outside of class to seem worthwhile.

Therefore, the purpose of this study was twofold: to formulate an aerospace education handbook providing pertinent information and material which may be woven into existing sixth grade courses in the elementary curriculum and to make a careful evaluation of one aerospace program in a sixth grade classroom.

The problems were: (1) selection and organization of appropriate information and material for the handbook; (2) determining suggested teaching procedures and activities; and (3) preparation and administration of evaluative instruments for the program.

Importance of the study. Educational leaders have long been sensitive to the problem posed by the cultural lag caused by the rapid technological advancement of our times. They recognize that a function of the schools is to narrow, as much as possible, the gap between the realities of the contemporary world and the comprehension by both youth and

adults of the meaning of these realities in relationship to their own lives. One way to prevent this so-called cultural lag, as pointed out by Harold E. Mehrens, is "to gear the schools' general education program to current affairs" (49:3).

In this study an attempt has been made to integrate aerospace information and materials into the elementary school curriculum in such a way as to enrich the classroom program by the use of these new materials, in which a keen interest already exists, to inspire children to a better understanding of the contemporary world, to improve attitudes, to strengthen and expand existing skills, to develop critical thinking concerning aerospace transportation and communication and their implications for their futures, and to further the understanding that aerospace activities and research will affect each person because they affect the way all people live and work and have greatly influenced the nature of our relationships with other nations.

II. DEFINITIONS OF TERMS USED

Aerospace Age. In this study, the term Aerospace Age may be defined as an age greatly influenced socially, economically, and politically by the universality of air and space vehicles.

Aerospace education. Aerospace education is that part of general education which deals with a non-technical study of aviation, missile and space research, and the effects they have wrought upon the social, economic, and political traditions of modern civilization and upon the nature of national and international relationships.

Direct-experience technique. An educational program designed to induct youth into the realities of life must employ whenever possible the direct-experience technique. Direct-experience technique is one which requires community-industry-education cooperation and the use of all available community resources and facilities in the daily experiences of youth, to aid in meeting the broad objectives of their general education.

Broad objectives. Broad objectives are defined as the general goals toward which the over-all school program is directed.

In this study the broad objectives in terms of the nature of learning and the responsibility of the school were:

> (1) Recognition of interest, purpose, and guided experiences in relation to child growth and development. (2) Recognition of responsibilities toward: (a) the child's development in understanding the complexity of modern life; (b) his development of the skills and attitudes essential to its improvement; and (c) the student's vocational efficiency. (3) Acceptance of a more integrated organization of the curriculum and use of the large center of interest as a frame of reference.

(4) Greater use of community resources. (5) Recognition of a responsibility for in-service teacher education (48:2).

CHAPTER II

HISTORICAL BACKGROUND OF THE PROBLEM

I. REVIEW OF THE LITERATURE

Although ever-present to some extent, criticism of education has recently established new records for volume, breadth of coverage, and intensity. Negative critics of newer trends in education have been quick to point an accusing finger at the schools for failure to teach the knowledge, skills, and mental habits necessary for effective handling of life problems. Defenders of education have been equally quick to respond to the criticism with action.

The rapid technological advances in recent years, especially in the fields of aviation and space research, have been responsible for much of the criticism and for a corresponding shift of emphasis in curriculum development in the schools in an effort to meet the challenge.

In 1903, Octave Chanute, one of the nation's foremost pioneers in aeronautical engineering, in commending the Wright Brothers following the historic flight at Kitty Hawk, had this to say: " . . . Its [the heavier-than-air craft] first application will probably be military . . . . The machine will eventually be fast; they [aircraft] will be

used in sport; but they are not to be thought of as commercial carriers" (60:181).

Chanute predicted accurately in the first three statements above quoted. That he failed to comprehend, in 1903, the tremendous role the aircraft has come to play in world affairs can be illustrated by any schoolboy conversant with the hundreds of tasks performed daily by aircraft in routine activities.

Mehrens cites the following illustration:

> Only thirty years after Chanute made his 1903 pronouncement, the aircraft made possible negotiations between American petroleum experts and Ibn Saud, late King of Saudi Arabia, which not only won the Arabian American Oil Company the right to develop one of the richest oil reserves of the world, but also brought in its wake a train of events which forcefully demonstrate the airplane's social significance.
>
> Saudi Arabia, because of the use of aircraft in commerce, was confronted with the problem of transforming itself from a feudal into a modern society without taking any of the intervening steps granted other social systems . . . . The oil interests there have been quick to educate the Arabs to an understanding of the aviation age and to perform the skills required of those employed in aviation (48:1).

Saudi Arabia is not an isolated case. The impact of aviation is felt in every corner of the world. Complex societies such as we have in the United States feel this impact much more keenly than do the more primitive nations. It is not surprising, then,

> that a group of forward-looking educators have seized upon aviation to symbolize the tempo of modern life. No other recent technological development in terms of its over-all impact can so well point up the dangers

> resulting from failure to make appropriate social application of and adjustments to the discoveries of science and the inventions that follow (48:2).

The content of aviation education prior to 1942 was generally focused on the science of aeronautics for the upper grades of the secondary schools. With the ending of hostilities in World War II, emphasis was shifted to the infusion of an aviation education program within the existing curriculum of the elementary school as well. "It is a tribute to good leadership and teachers that few, if any, schools in our country have failed to respond to the new educational needs created by aviation and related developments" (61:vii).

Recent advancements in air transportation and communication and other technological developments which aviation has brought in its wake have produced and will continue to produce many problems directly affecting the lives of boys and girls as well as the lives of adults within our society.

> We are living in an age of rapid change. Teachers did not make and cannot stop the change. A changed and changing era is here. It affects what shall be taught (41:12).

An epochal change has arrived, and with it a whole new vision of the tasks open to man. In a June, 1956, issue of Life magazine, Charles J. V. Murphy reported:

> . . . . The airplane is shaping anew the habits and opportunities of American society . . . . As

> aviation grows, the supporting industries mushroom everywhere around it . . . . (51:136).

Bryan corroborates this viewpoint by saying:

> The youth of today must have an appreciation and awareness of the history, practical effect, and future potential of this transportation giant [aviation]. Only through an understanding and application of aeronautical principles, by both present and future generations, will the United States be able to maintain its airpower position. Many young Americans have already realized the value of a technical aviation education . . . and are well on the way to participation in the Aerospace Age (43:1).

Air technologies are reshaping our geography on every hand, and we have just crossed the threshold of the Aerospace Age. Rickenbacker warns:

> . . . . The daily management of the U. S. air is one of the most complex and intricate operations done by man . . . . We are absorbing the air age revolution without really understanding it . . . . The need and the will to master the world's air has brought changes which are reshaping our economy, our cities, and our global relationships . . . . Its [the Aerospace Age] true wonders are not yet at hand--they are only imminent . . . . [This is] the first true airborne generation (59:2).

As this review progressed, the relationship of the demands of the Aerospace Age to American education emerged. We stand at the threshold of the Aerospace Age. Man's conquest of the realm of flight during the past half-century has been a series of courageous advances. It is not necessary to cite statistics, as universal acceptance of the achievements is proof in itself. This is not, however, the time for complacency. Peoples of the world find themselves in an Alice-in-Wonderland situation where

they must run in order to stay in one place. The aircraft industry has grown to the point where, today, it has become America's largest industry. Bryan says:

> Historically, more people have been employed in the automobile industry than in the aircraft industry. However, in 1957, employment in the aircraft industry passed the automobile industry. In 1958, the aircraft manufacturing industry employed 758,000 people compared to 627,000 employed by the automobile manufacturing industry (43:2).

Bryan continues:

> The foundation for this . . . increase and growth of the industry is the national defense program. In recent years, over 50 per cent of the federal government's budget has been allocated to national defense; of this, a significant portion has been diverted to the aircraft manufacturing industry for research, development, and production work on airplanes, missiles, and spacecraft. Today over 85 per cent of the dollar sales in the aircraft industry is to the military services. In 1959, commercial jet airliners [were] expected to increase total sales of the industry about 20 per cent or by over $2 billion (43:2-3).

Yes, the youth of today must be given an opportunity to develop an appreciation and awareness of the potential of this transportation giant, must be given the opportunity to evaluate his position in the present age--but just as important is the need for an awareness of the advantages and disadvantages, privileges and restrictions, rewards and consequences of expanding aerospace activity and research in the world of today and tomorrow, for the impacts are economic, social, political, as well as military in nature and have an inescapable and overwhelming effect on day-to-day living.

We must agree that aviation exerts considerable influence upon the economic activities of mankind today. Furthermore, it consumes a sizeable part of the total defense budget sustained by all taxpayers in this country.

Commercial aviation promises to revolutionize air travel as it enters a new era, and general aviation is coming into its own with the growing use of smaller aircraft now that aircraft ownership costs appear to be falling within the reach of hundreds more people.

Sociological changes have followed--an increased living tempo, new markets, and a redistribution of the world's population. Family life has been changed, partly by choices of vacation sites and in dispersion of family members to different geographical areas. Eating habits have been changed, even, with speedy transportation of perishable products.

Politically, the airplane has changed military concepts. Not only does the United States Air Force have equal status, today, with the Army and Navy, but in international affairs, we have been forced to re-evaluate our role in diplomatic relations. Political leaders, taking advantage of airplane mobility, are now able to cover more territory and speak to more people during campaigns than ever before.

Yes, "formal education will be vitally affected by aviation with all phases of the present educational system directly influenced by aviation activity" (43:9).

Further progress will be the result of skillful preparation on the part of our young people. We can no longer assume that enough young men and women will choose careers in line with their maximum potential. The need is urgent, the time limited. If we are to accept this challenge--in other words, if we are to survive economically, we must fulfill this obligation in the most efficient manner.

The price of education is a relative thing. Compared with the cost of indifference or intolerance, it becomes pitifully small. We cannot expect to reap the harvest without first sowing the seed, nor can we demand a better way of life without conscientious effort to improve it.

> Topics for consideration in classrooms . . . during the space age will include such areas of scientific interest as those suggested by space science, satellites, . . . weightlessness, extremes of heat and cold, cosmic radiation, meteorites, the hazards of prolonged isolation, and the transition from terrestrial to celestial operations. It will also include considerations of implications for social science as well, with the constant concern for America's national prestige and safety in the race for control of outer space. A whole new galaxy of literature will come into being as we make a transition from, "So I looked into the future far as human eye could see, saw visions of the world, etc." to a more recent contribution by Werhner von Braun, "There is beauty in space, and it is orderly. There is no weather, and there is regularity. It is predictable . . . . Everything in space obeys the laws of physics. If you know these laws, and obey them, space will treat you kindly. And don't tell me man doesn't belong out there. Man belongs wherever he wants to go" (36:3).

The enormity of the task of present-day educators takes shape in view of such studies. Few would deny that the

school is responsible for developing the child's understanding of the world in which he lives and for his acquiring skills and attitudes to enable him to cope with the problems his world imposes upon him.

It appears that the educational leaders who deny aerospace studies a place in the schools' curricula regard them, not as a means of meeting life's problems, not as a source of enrichment for the traditional content fields and classroom activities, not as a means of motivating study of the basic subjects, but as a discrete subject of study. They must, therefore, vie with other subjects for acceptance. something regarded less important may have to be rejected to meet their demands. All of this accepting and rejecting will have to be done in terms of the intrinsic values received.

Adjusting the school's program to the Aerospace Age can be done, however, in terms of youth's needs and problems. In a study involving thirty-two of the nation's largest schools, "it was discovered that aviation education can reinforce certain major trends in curricular improvement" (48:2).

The findings of Bruner (48:2) aid in pointing the way toward integrating aerospace materials in several areas of the curriculum, predicated upon a sound conception of the general aims of education.

However, Griggs warns:

> Some are concerned lest more be placed in the curriculum than can possibly be taught; but interest in aviation could be a means of causing more learning in other subject-matter fields--social studies, science, reading, and arithmetic, for example. Aviation is an interest center. It is not a new course in the elementary curriculum. It is not a matter of choosing between providing for some new of the new interests [sic] which are in the experiences of children in the modern world and developing the skills for learning. It is possible to do both, and to do them better because of doing them together (41:12-13).

If this is to be accomplished, it will be necessary to keep in mind the ability levels of youth in terms of what is now known about how children grow and learn. For those schools which have adopted the core (common learnings) or the block-of-time approach to program development, there is great opportunity for the pupils and teacher to follow through with direct-experience activities which perhaps best facilitate the use of community resources--an important part of the aerospace education program.

The experienced teacher is sobered by the fact that he is working with elementary school children and by the realization that the implications of this study are many and varied in every area. He knows that he must proceed only so far as the study can have real-life meaning for his students.

The area is a broad one. Not all children will develop identical interests. Some may go much farther than others in understanding the significance of the study. Since

this is true in any educational endeavor, it need not mean that work on aerospace in the elementary school just skim the cream; it may, rather, make the children more alert to the paths of interest and adventure yet to be explored.

Teachers who have the spirit of adventure find much joy in teaching, for it is the spark which kindles enthusiasm and interest in the children. They recognize the fact that the youngsters often may have greater knowledge than the teacher of some particular phases of aerospace education. However, such teachers will not hesitate to capitalize upon this student interest and acquaintance with aerospace information, knowing full well the greater understandings, appreciations, attitudes, insights, habits, and skills which grow out of experiences based on cooperative group enterprises of problem-solving drawn directly from student interests.

The wise teacher will find out what experiences the group has had in previous years and what leads are most natural for the group. These will determine the specific approach for the study ahead.

II. SUMMARY

This chapter has presented a brief review of some of the important writings dealing with the problems confronting educators in their attempt to meet the needs of today's youth

in a world strained by the rapid technological advancements of the Aerospace Age.

The concensus seems to be that the Aerospace Age promises to be one of the most challenging, frustrating, exhilarating, fatiguing, promising, demanding, yet intriguing experiences in the history of mankind.

CHAPTER III

A TEACHERS' GUIDE TO AEROSPACE EDUCATION

I. INTRODUCTION

Only in the classroom can problems in educational methods and procedures be solved. Only in the classroom can the theories and proposed practices outlined by experts be tested and modified and practical procedures evolved. Likewise, only in practical classroom situations can methods of aerospace education be discovered or devised.

This handbook for aerospace education in the sixth grade is a compilation of suggested concept areas, containing important information, basic understandings, problem areas, experiences, related resource materials, including references and audio-visual aids, and suggested evaluations which may prove as helpful to other sixth grade teachers as they were to the writer in initiating, conducting, culminating, and evaluating the aerospace information integrated into the existing curriculum.

The criteria for selection and organization of materials were:

1. The significance of the fields of aviation and

space research to young people and society in our changing world.

2. The adaptability of the material within the existing framework of the school curriculum.
3. The nature of child development as reflected by maturity, interests, concerns, problems, and misconceptions of young people of this age group.
4. Ready availability of the materials at the time the study was made.
5. The contribution of the materials to the unity of the study.
6. The facility of use.

The handbook itself is designed to be suggestive rather than exhaustive and to be stimulating in the possibilities it opens up. Experiences listed may bring about desirable changes in the way children think, feel, and act. Teachers and children will want to make careful choice of those they wish to undertake or undergo.

Teachers participating in this type of program should be successful, experienced teachers, thoroughly conversant with a given school's curricular point of view. A school's accepted philosophy should not be tampered with, without careful consideration of proposed changes.

It should likewise be stressed that the purposes of the study adhere to the degree of understanding and

development appropriate to the grade level in which it is being presented.

In integrating the material with the entire school curriculum, including the language arts, mathematics, science, social studies, music and art, it should be remembered that it is important to teach desirable social attitudes and understandings as well as the development of research skills.

The teacher should be aware of some of the obstacles to be encountered in undertaking such a program. Because of already-crowded schedules, administrators hesitate to introduce another subject; teachers admit ignorance of the subject matter of aviation; the children already know more about the subject than do many of their parents or teachers; and graded materials are not readily available for instruction.

Such obstacles to the use of such a program may appear insurmountable. However, these obstacles, now a handicap, may yet be one of the program's greatest advantages because the lack has imposed upon classroom groups the need to exercise initiative in securing materials from sources of current events. Thus the program has been strengthened and the attention of pupil and teacher faced toward the future. Materials resulting from teacher-pupil investigation of the current scene play a great part in meeting the established goals.

In each section of the handbook, systematic attention was given to development of carefully selected social and scientific concepts.

To assist in securing an overview of possible outcomes of learning, a chart illustrating continuity in learning has been organized (see Table I). Examination of the scope and sequence shown in the chart will reveal the pattern for development of the desired understandings.

Examination of the continuity chart will also show that the scope of the material is contained within three large categorical areas. These may be summarized as the following theses:

Thesis 1. Man lives in a continually changing world in which aerospace activities have been and will continue to be important factors.

Thesis 2. Many people have contributed to the progress of aerospace activities.

Thesis 3. Aerospace activities make all people of the world our neighbors.

In each category, important information and generalizations in the form of basic understandings are presented. The generalizations are to be thought of as possible directions of development through direct experiences rather than as concepts to be taught directly. In conjunction with the generalizations are found the suggested experiences for developing them.

Far more experiences are included herein than would be desirable to use with any group of children. Selection and organization of this material should be made so that it results in the most profitable experiences and learnings for the young people involved. Neither should the teacher limit himself to these experiences. They are merely suggestive of other and perhaps much more worthwhile learning situations that may be developed through teacher-student planning.

II. ORGANIZING THE STUDY

The teacher's enthusiasm is the first essential in undertaking any study. After exploring the available materials and possible experiences in the fields of aerospace activity, his own enthusiasm should emerge. He then considers various ways of integrating aerospace information into the curriculum. Different approaches are suggested (38:2-4):

1. Children's interests

> The airplane is an interest common to practically all . . . children and to boys especially. Most boys identify everything that has two wings and an engine. They build airplanes, collect pictures of them, argue hotly over the advantages of one type of aircraft over another, and dream of the not-too-distant days when their hands will be at the controls. Such general widespread interest alone assures the teacher that this . . . belongs in the . . . sixth grade and suggests in itself one good approach.

2. Personal experience

> Most of the children have undoubtedly experienced flight or visits to the airport or air terminal. Others may have relatives who are directly concerned with aviation. There are all degrees of personal experience. Any such experience may become a starting point for the study in terms of its significance and meaning to one or several children.

3. Enthusiasm of a child

> In another situation, an enthusiastic child may suggest finding out about aviation. Others may come in with airplane or missile models or souvenirs and some thrilling suggestions as to what can be done in a study of aerospace activity.

4. Vision of the teacher

> In some instances the teacher may provide the incentive. He may realize that aerospace activities are so important in the world of today and tomorrow that something should be done about the matter in the classroom. He may set the stage for the study with books, pictures, maps, and charts to exclaim over, examine, and discuss. Or if he wants the children to share the responsibility for bringing in and arranging aerospace materials later, he may use other devices. He may show a film, invite a speaker to talk to the group, or recount an experience of his own concerning aviation.

From any beginning, the next step might logically be a period of time for exploring the materials and problems. This exploratory period may continue for several days as children browse through magazines, newspapers, books, charts, materials from home, or trace imaginary journeys on a map or globe.

This process of exploring should probably include daily discussions in which the children talk freely about what they are reading and doing. Questions which indicate their interests and concerns will soon come bubbling out. At this point, the Pupil Questionnaire (see Appendix A) may be used to record the questions in preparation for choosing topics for study. Thus the teacher and children, working together, formulate the problems to be undertaken.

The questions raised in the exploratory period will undoubtedly indicate a wide range of interests. Perhaps the best way to care for such breadth of interests in different problems is by organizing the class into groups. In the beginning, it may be a good idea to limit the number of groups to three or five. As time goes on, some adjustments may be necessary to meet the established goals.

As the children volunteer to work in different groups, the need for providing materials of varying degrees of difficulty becomes evident. This situation makes its greatest demand in the field of reading. Materials provided must be from those classified as "easy" to those on an adult level. These are not readily found, but a trip to the libraries in the area in search of such materials may prove helpful. The teacher may find it necessary to write his own for the benefit of those children less advanced in reading skill.

Now that the guideposts have been established, we proceed to the next phase, namely, the means through which we solve the problems. Here the children explain the things they can do, the excursions they can take. (These are listed as activities and experiences in the teacher's plans).

The direction the study takes at this point and the activities to be carried out are determined largely by the nature and needs of the children in the class. These needs will undoubtedly be expressed in many areas and some degree of growth can be attained in all of them. Specific objectives toward which teacher and children may work are then established.

The following objectives are suggested as a guide:

1. To understand that since man lives in a continually changing world in which aerospace activities have been and will continue to be important factors, we need to understand something of the history of man's fight to fly and we need to develop a general knowledge of the simple scientific principles of aviation and space research and the services they render society.
2. To understand that since many people have contributed and are now contributing to the

progress of aerospace activities, we need to develop an appreciation and respect for the work and achievements of these pioneers.

3. To understand that since aerospace activities make all peoples of the world our neighbors, we need to develop an understanding and appreciation for the ideas and opinions of others in order to live peacefully in a world community.

Whether or not the class is accustomed to group organization, it will run into some difficulties in getting its work done. There will be some problems in getting along with each other. It would be desirable for the class to establish reasonable, attainable rules to follow. Rules similar to these may evolve:

1. Know what we want to do.
2. Limit activities to those we can do.
3. Establish standards to judge work and progress.
4. Get to work immediately.
5. Do my part. This means share tools, books, paints, and help at clean-up time.
6. Take proper care of supplies.
7. Stick to the job until it is finished.

It is suggested that the list be written on a chart, kept before the group, referred to and revised as occasion

demands. Discussing behavior as it impinges on the welfare of others is not something done once and for all, but is rather a recurring problem.

The common interests and needs expressed in the problems to be solved give purpose and direction to the work to be done. As plans for the solutions evolve, individual responsibilities and cooperative effort become apparent.

Group planning, group decisions, and group evaluation are essentials of the democratic process. The procedure may take longer than when the teacher outlines all activities and procedures, but it pays rich dividends in terms of child development if carefully directed.

Specific demands upon the teacher in this procedure include:

1. Helping each group to get organized.
2. Determining if each child has helped to set up group goals, knows what is expected of him in the way of locating material, organizing and recording it, and sharing it with other groups.
3. Discussing daily with the entire class the day's outline of work.
4. Aiding plans for summarizing information, judging progress, and planning further work.

Evaluation is a continuous process where teacher and children are working on a common interest. Suggested means

include: a daily cooperative, informal discussion of simple notes taken on readings, outlines made in organizing materials, and stories written. We listen to the comments offered, the questions asked, the responses made, and suggestions given. The thoughtful teacher realizes that everything a child does and does not do provides an opportunity to evaluate the child's growth. Use of pupil self-evaluation and teacher evaluation check sheets similar to the samples in Appendix B may prove helpful. Growth and improvement in skills and attitudes as evidenced in behavioral terms, then, is the primary criterion for evaluation.

III. SUGGESTED AREAS TO EXPLORE

This section is a resource to which teachers and children alike may turn to find information to assist in an aerospace study.

The material suggested presupposes a question and purpose in the minds of the children who may use it. Since aerospace activities are continually in operation, the user is advised to add new information as it develops so that the guide is always up-to-date.

The guide has been organized in the following manner: an outline of the three major concept areas covered, including the problem areas, basic understandings which should emerge, and important information necessary to develop the

concepts. This is followed by a continuity chart (Table I) listing the three suggested concept areas, the problem areas, basic understandings which may emerge, suggested experiences, and references.

Like letters and numbers were assigned to the corresponding problem areas, understandings, experiences, and references to facilitate use of the continuity chart as a teaching guide.

The problem areas were subdivided into logical groupings to facilitate choice of materials to be undertaken or used.

Thesis 1: Man lives in a continually changing world--a world in which aerospace activities have been and will continue to be important factors. Therefore, we need to understand some of the history of man's fight to fly and we need to develop a general knowledge of the scientific principles of aviation and space research and the services they render society.

Aerospace Changes

A. Problem area: How are the people in the world influenced by changes of the Aerospace Age?

   1. Basic understanding: Aviation has brought about many social, economic, religious, and political changes.

2. Important information: Social and religious problems lie in the changes necessary to provide for the educational, religious, and recreational needs of the family in the newly-created world community; in overcoming the existing barriers of folk customs, languages, expression in the arts, sports, and amusements of other regions; in the clashing of religious ideologies; and in the new growth of cities and nations brought about by the redistribution of the world population.

Economic problems lie in the significance of the population shifts in relation to the world's resources; in the changed conditions that influence trade and employment; the need for wise use of the world's resources; the interdependence of the people of the world in meeting their economic needs in trade and industry; and in improving or maintaining their standards of living.

The political problem is a lack of international understanding and confidence in other forms of government and an appreciation of their problems in relation to our own.

3. Basic understanding: Aerospace activities provide jobs for millions of people.

4. Important information: Several hundred thousand persons are industrially employed in the field of aviation. Millions of passengers fly on commercial airlines each year for both business and pleasure.

Categorically speaking, there are three basic areas in aviation: (1) the aircraft manufacturing industry, both civil and military; (2) the air transport industry; and (3) general aviation.

5. Basic understanding: The airplane has conquered all physical boundaries, since the air is a universal medium reaching every point on the earth's surface.

6. Important information: No longer do mountains, arctic climates, and oceans provide national security. The airplane and missiles have reduced the size of the world so that continents and hemispheres have disappeared in global thinking.

Development of air transportation has brought the world to our door and with it the world's problems. It is no longer feasible to teach of distant lands when no spot on the globe is more

than a few hours away by jet plane, or when frequent launchings of earth satellites and missiles into space are commonplace news in daily newspapers, on television, and radio broadcasts.

B. Problem area: Why is it impossible to picture the world in only two dimensions?

1. Basic understanding: Accuracy in picturing the world in only two dimensions is impossible because the world is a globe.

2. Important information: Map distortions which caused misrepresentations of continental relationships were unimportant as long as water transportation alone linked the world. Now that it is possible to use the polar routes, the concept of the direction of travel has changed from one of east-west to one of north-south.

3. Basic understanding: The Great Circle route, the shortest route from place to place, does not appear as a straight line on most flat maps.

4. Important information: Since much of the world's lands and people is centered around the north polar area, many of the Great Circle routes

cross this area, giving new prominence to it in world travel and world geography.

5. Basic understanding: We live in a shrinking world, and our community has expanded until it includes the entire world.

6. Important information: The airplane makes it necessary to live compatibly with all peoples, regardless of creed, color, or ideology--it does so perhaps more than any other single invention in the world today.

History offers little precedent to help solve problems created by the universal use of air and space vehicles.

C. Problem area: Why is international control of aerospace activities essential?

1. Basic understanding: National and international regulation and control of aerospace activities are essential for safety and world peace.

2. Important information: International understanding and confidence, an understanding of the cultures of other countries, and an appreciation of their problems are essential for world peace.

The airplane can bring representatives of all nations together, and space vehicles can bring the activities of all nations under constant watch.

A workable world political organization seems necessary to handle global and space problems.

Interplay of Forces that Affect Flight

A. Problem area: What makes an airplane fly?

1. Basic understanding: Air has certain characteristics which make flight possible.

2. Important information: Heavier-than-air aircraft fly because their construction is based upon principles established as scientifically sound.

Air is a real substance, and, as such, it resists objects moving through it. Air has weight, is compressible, and exerts pressure, and when flowing over a surface, exerts less pressure as its speed is increased.

B. Problem area: What permits an airplane to leave the ground and sustain itself in flight?

1. Basic understanding: There are four forces working upon an airplane in flight.

2. Important information: Thrust pulls the plane forward. Lift holds the plane in the air. Drag tends to pull the plane back, and gravity tends to pull the plane downward.

3. Basic understanding: The general structure of the airplane makes possible controlled and safe flight.

4. Important information: To help understand the nature of the reaction between a moving wing and the air through which it flies, it is necessary to understand the scientific principles whose applications make this reaction possible. One of these is known as Newton's Law of Action and Reaction. Examples would be the recoil of a gun, the backlash of a hose as water leaves the nozzle, and gravel thrown by a tire.

Newton's observations led him to conclude that an object acted upon tended to resist the action with a force equal to the force applied to it. He said: "For every action there must be an equal and opposite reaction." A moving airplane wing acts upon the air. Consequently, in accordance with Newton's Law, the air must act upon the airplane wing.

Another of these principles is the Bernoulli law of pressure-differential which states, in brief, that as the velocity of a fluid increases, its pressure decreases (and vice versa). An example of this is the venturi tube which is wide at each end but narrow at the throat between the openings. Moving air will speed up when

passing through the narrow part of the tube, hence the pressure at this point is reduced.

An airplane is constructed to take advantage of these principles and is thus able to fly safely and under control of the pilot.

C. Problem area: What controls permit the pilot to fly his aircraft? What are the names and locations of the major parts of the airplane? What shows the pilot how his aircraft is performing correctly? How does an airplane take off, climb, dive, turn, land, and perform in general?

1. Basic understanding: Airplanes are constructed to make use of, or to overcome, the forces acting upon them.

2. Important information: The moving aircraft wing reacts with the air through which it moves. Through the application of power to the resistance of the air, airfoils are made to life and support a given weight in flight.

The airfoil or upper surface of an airplane wing is shaped somewhat like the inner surface of one-half a venturi tube split lengthwise. Consequently, the air moving over the wing moves more rapidly than that moving under it. As a result the air pressure above the wing is less

than that below it. As a result, lift forces are created. The wings thereby utilize the characteristics of air in two ways to provide lift: the air above the curved surface of the wing exerts less pressure as it is made to flow more rapidly, and the air under the wing pushes up as the pressure from above is lessened.

The engine-driven propellers make use of air as a real substance. They bite into it as the threads of a screw bite into a pine board. This provides thrust.

Airplanes are streamlined in shape as much as possible, with curved surfaces and few projections to offer less resistance to the air and thus reduce drag.

Additional control surfaces make use of resistance to air in piloting the plane. The rudder controls the direction of flight by impressing yawing movements on the craft. Ailerons control the roll of the plane. Elevators steer the plane up or down, or control the pitch of the plane.

Gravity is overcome as lift is provided through airplane construction.

Aircraft

A. Problem area: How are aircraft classified?

1. Basic understanding: Aircraft may be classified according to relative weight or displacement (heavier-than-air and lighter-than-air); provision for propulsion; provision for take-off and landing; according to wing construction; and according to use.

2. Important information: Types of heavier-than-air aircraft include the monoplane--a plane of one-wing construction with one or more engines; the biplane--a plane of two-wing construction with one or more engines; the delta wing--a plane with wing construction shaped like the Greek letter for D; the sweptback wing--a plane with wing construction which tapers back from the wing root to the tip at varying angles; the seaplane--a plane with pontoons or a special hull enabling it to land on water; the amphibian--a plane with retractable wheels in the hull, enabling it to land on either land or water; the glider--a plane with no engine, depending upon air currents for flight; the helicopter--aircraft with whirling blades called a rotor on top and small propellers on the side or rear of the plane, both driven by

the engine; and jet planes--planes utilizing jet propulsion to provide thrust.

Planes may also be classified according to provision for propulsion: nonpowered gliders and balloons, powered airplanes and dirigibles. Other classifications may be according to provision for take-off and landing: seaplanes, land planes, and amphibian planes; according to wing construction: monoplanes, biplanes, delta wing planes, or sweptback wing planes; or according to their use: commercial, military, or private.

B. Problem area: What are the services of planes?

1. Basic understanding: Services of aircraft include transportation of people and cargo, defense, protection of natural resources, and emergency services. These fall into three main categories: military, commercial, and general aviation.

2. Important information: Today's uses of the airplane include many emergency services: rescuing ill, injured, or stranded people; delivering food and medicine; studying flood conditions and helping to control them; and spotting and fighting forest fires.

Services in communication and transportation include reporting news events and taking news photographs, delivering mail, furnishing transport to otherwise inaccessible places, surveying for the construction of roads, delivering weather warnings to ships, and carrying passengers.

Services to agriculture include studying the soil, planting crops, spraying and dusting crops, and spreading fertilizers.

Services to industry are, among others, carrying freight, delivering fragile and perishable goods, carrying machinery and parts for emergency needs, surveying forests to locate stands of timber, and locating schools of fish for commercial fishermen.

Services to science include studying germs in the air, making experimental flights to study air and space conditions, and controlling pests.

C. Problem area: How are aircraft identified?

1. Basic understanding: Airplanes are identified by size, shapes, and parts and their locations; by markings and armament; and are named according to code designations.

2. Important information: The wings are classified as to number, shape, position and direction of sweep. Engines vary as to number, type, and

location. Fuselages differ as to length, width, depth, and degree of streamlining. Tail surfaces are of two general types: single, consisting of fin, rudder, stabilizer and elevator; and the twin, consisting of two fins and two rudders.

The undercarriage or landing gear can be stationary or retractable (folding into either the wing or fuselage). The rudder may be of various shapes: elliptical, triangular, or cut off in a sharp vertical line. Noses vary widely, also. They may be blunt, indicating a radial air-cooled engine, or may come down to a point, indicating a liquid-cooled engine.

Airplanes are identified by code letters and numbers. What do the letters and numbers mean? All United States Air Force planes carry certain markings, prescribed by international law and directives of the Air Force. These include the red, white, and blue National insignia, USAF initials on the wings, "U. S. Air Force" on the fuselage sides, serial numbers, model numbers, radio call number and "buzz" or identification number, used only on fighters, light bombers, trainers, and liaison aircraft.

The size of lettering and the placement on the Air Force aircraft of the lettering is covered by United States Air Force manual T. O. 07-1-1. All numbers are derived from the serial number, which is placed on the aircraft at the factory and remains on the aircraft as long as it is in service.

United States Air Force type designations include:

A	Amphibian
B	Bomber
C	Cargo and Transport
F	Fighter
H	Helicopter
K	Tanker
L	Liaison
Q	Target and Drone
R	Reconnaissance
S	Search and Rescue
T	Trainer
U	Utility
X	Experimental

United States Air Force model identification includes:

Bombers:

26	C
25	D
45	E
57	A
66	B

Fighters:

47	E	94	A
51	F	100	W

Fighters (continued):

80	T	101	B
82	Q	102	C
84	S	103	D
86	U	104	G
89	V	105	H

Manufacturers' letters used in identification of United States Air Force aircraft include:

BH	Beech
BE	Bell
BN	Boeing, Renton
BO	Boeing, Seattle
BW	Boeing, Wichita
CE	Cessna
CO	Convair
DH	DeHavilland, Canada
DO	Douglas, Santa Monica
DT	Douglas, Tulsa
FA	Fairchild
LO	Lockheed
MA	Martin
MC	McDonnell
NA	North American, Los Angeles
NH	North American, Columbus
PI	Piper
RE	Republic
SI	Sikorski

The serial number is stencilled on the left side of the fuselage at the cockpit, along with the type and model designation. For example, we can consider an F-86H Sabre with the following numbers appearing at the cockpit: F-86H-1-NH
52-2050

F Letter "F" indicates fighter type

86 86th fighter type ordered by the Air Force

H "H" modification of this type

1 Manufacturer's block number. This aircraft was assembled in the first block of this

type and model. Block numbers are assigned in multiples of 5. First block is number 1. The next block is number 5, then 10, 15, and 20. Numbers in between are used for in-the-field modifications.

NH Manufacturer: North American, Columbus.

52 1952--Fiscal year (beginning July 1, 1952) in which aircraft was ordered. Not necessarily year in which it was built.

2050 2050th aircraft contracted for in 1952 fiscal year.

The radio call number is lettered on each side of the vertical stabilizer and consists of the last number of the year date plus the serial number (22050). There must be a minimum of four numerals, and some later planes have five. Zeros are inserted after the year date if the serial number is lower than 100.

The identification or "buzz" number serves to identify the aircraft in the air from a distance. The first letter is the aircraft type (F for fighter). The second letter identifies the model ("U" is assigned to the F-86). The numbers are the last three numbers of the serial number: FU-050.

The United States Navy uses different letters to show the uses of its planes, and gives still

more history in its designation. The manufacturer is designated by a letter in the code also.

United States Navy type designations include:

A	Attack
B	Bomber
F	Fighter
O	Observation
P	Patrol
PB	Patrol bomber
R	Transport
S	Anti-submarine
T	Trainer
U	Utility
V	Convertiplane
W	Special research

As examples, we can consider a PB2Y-2 and a P6M-1.

PB	Patrol Bomber
2	Second model built by
Y	Consolidated
2	Second modification of the model

and

P	Patrol Plane
6	6th model built by
M	Martin Company
1	1st modification of the model

D. Problem area: How are airplanes serviced and maintained?

1. Basic understanding: Special care is given to commercial planes which carry passengers. Safety

in the air depends upon the care and precision of maintenance on the ground.

2. Important information: Airplanes must be kept in perfect mechanical condition. A program of continuous maintenance is followed by all airlines. All airlines check every aircraft and its powerplant before each flight; all conduct daily inspections of equipment. Some companies rebuild airframes after each 8,000 hours of flight time. Engines are rebuilt after the engine has logged from 600 to 2,000 hours, depending upon the kind of engine in use.

The men and women who repair and maintain aircraft must be trained for their job and skilled in its performance.

Workers who keep the planes flying include mechanics, repairmen, ground men, engineers, firemen, inspectors, electricians, dispatchers, and meteorologists.

E. Problem area: What will future planes be like?

1. Basic understanding: Future aircraft will include many different kinds of planes, depending on the particular purpose for which they will be used. Changes in design, performance, and propulsion may be made.

2. Important information: Jet propulsion will continue to increase speeds of planes. As speeds increase, or as types of propulsion change, changes in the designs of planes and types of performance may be expected.

Some type of roadable plane may be the solution to the problem confronting the extensive use of light planes for private owners.

As experimentation continues, such as the research being done by the X-15 and Project Mercury, space craft may become necessary.

Airports

A. Problem area: What is an airport?

1. Basic understanding: An airport serves aircraft in all ways.

2. Important information: Airports or air terminals used by transport planes flying scheduled flights must provide accommodations and facilities for serving passengers and planes and have adequate runways for safe landings and take-offs.

Smaller airports with less extensive facilities serve the needs of planes flying non-scheduled flights.

In addition to the runways for take-off and landing, airports usually include terminal buildings, hangars, all-weather landing equipment, and adequate lighting facilities and traffic control.

B. Problem area: Why is airport traffic control necessary?

1. Basic understanding: Air traffic control is essential to safe flying.

2. Important information: Air traffic regulation is important in the interest of safe operation of aircraft. It is essential to modern aircraft operation because the flow of traffic in and out of modern airports is so heavy that without it, maximum use could not be made of the facilities, and serious traffic conflicts would occur.

An aircraft to stay aloft must keep in continuous motion; there can be no pauses in the flow of traffic as is possible with automobile cross-traffic. Also, during instrument flight conditions (when vision is obstructed for some reason) travel becomes hazardous when no control exists. For, if one aircraft were permitted to fly at any altitude and along any course it desired, other aircraft would have the same

privilege, and collision between the two during low-visibility weather conditions would be likely.

Airways

A. Problem area: What is an airway?

1. Basic understanding: Airways are highways of the air.

2. Important information: Airways are the air highways followed by aircraft in flight. An airway extends thousands of feet up into the air and is ten miles wide. Airways are well-marked by direction signs, radio signals, and lighted beacons to help keep aircraft on their courses in any weather.

More than 70,000 miles of marked airways span our country from coast to coast.

B. Problem area: How is flight controlled along the airways?

1. Basic understanding: Navigation facilities are provided to make airways safe for air transportation.

2. Important information: Air traffic is controlled by the federally-operated Air Route Traffic Control system and by the local field control tower. Air traffic arriving at or departing

from a field is guided and directed by the control tower. After leaving the control tower's jurisdiction, all controlled flights are handled by the Air Route Traffic Control (ARTC) system which separates flights by time and by altitude. Private pilots whose flights are not being controlled may use the airways, provided they follow the regulations of the Federal Aviation Agency governing use of such airways.

Flight levels separate airplanes according to their direction and place of flight.

Weather information is provided to pilots in forecasts by the United States Weather Bureau. Many airports and airlines hire meteorologists to forecast weather for their special operations.

Weather is the most important single factor in airway traffic control.

Spacecraft

A. Problem area: What are rockets, missiles, and satellite vehicles?

1. Basic understanding: Rockets operate on the principle of action and reaction, burn a fuel-oxygen mixture, exhaust burning gases created

by the fuel mixture, and carry their own oxygen.

2. Important information: Jet engines and rocket engines are often confused. Both operate on the principle of action and reaction, both burn a fuel-oxygen mixture, and both exhaust the burning gases created by the fuel mixture. The one important difference is that the jet engine gets the oxygen it needs for combustion from the outside atmosphere while the rocket carries its own oxygen. A jet can operate only within the earth's atmosphere, but a rocket can operate anywhere.

3. Basic understanding: Basically, a missile is an object thrown at a target, i.e., a weapon.

4. Important information: There has also been confusion in the difference between a missile and a rocket.

In modern military usage a missile is a powered vehicle designed to carry explosives to a target. There are at present two types of missiles: (1) the guided missile, capable of a change of direction by internal or external command at any time during its flight; and (2) the ballistic missile, powered and guided for the first part of

its flight but becoming a free-falling body in the latter stages of its flight.

The term rocket refers only to the type of propulsion. Many missiles are rocket-powered, and one may, therefore, want to call them all rockets, but a rocket can perform many other jobs--mainly the propulsion of vehicles into space.

5. Basic understanding: Satellite vehicles are the rockets used to launch man-made satellites into orbits in space.

6. Important information: Today's intercontinental and intermediate-range ballistic missiles will be man's springboard into space. Putting a satellite into orbit--once the propulsion and guidance systems have been produced--is simpler than putting a warhead on a target halfway around the world.

Basically, a satellite is put into orbit by attaining a speed somewhere above 18,000 mph but less than 25,000 mph. The satellite is projected far enough out and at a fast enough speed so that the earth's gravity does not pull it back, yet it is not going so fast that it will be released from the earth's gravity and fly into space.

Satellites remain in orbit for the same reason that the moon and planets remain aloft. There is a balance between the earth's gravity and the satellite's centrifugal force.

Between October, 1957, and January, 1959, Russia and the United States put seven artificial satellites into orbit. Between January, 1959, and June, 1960, Russia has launched Lunik I, III, and IV, although Air Force experts say that Lunik III apparently re-entered the earth's atmosphere and burned up about May 20, 1960.

The United States, between January, 1959, and June, 1960, has successfully launched Explorer I, VI, and VII; Vanguard I, II, and III; Pioneer IV and V; Tiros; Discoverer XI; and Transit I-B and II-A. These were still in orbit during June, 1960.

B. Problem area: How are missiles classified?

1. Basic understanding: Missiles are classified according to use.

2. Important information: Following is a list of "the missiles, drones and test vehicles which the Department of Defense has cleared for public release" (52:20-45):

Name	Brief Description
Atlas	America's first intercontinental ballistic missile
Titan	Intercontinental ballistic missile
Polaris	Intermediate range fleet ballistic missile
Thor	First American intermediate range ballistic missile
Jupiter	First American intermediate range ballistic missile to be successfully fired
Redstone	First ballistic missile to be deployed overseas
Regulus I	First operational attack missile to join the Navy fleet
Snark	Intercontinental missile of the air-breathing variety
Corporal	Army's first ballistic-type weapon
Sergeant	Short-range ballistic missile
Mace	An air-breather replacement for Matador
Matador	First Air Force missile to attain operational status
Little John	Free flight rocket without electronic controls
Honest John	Artillery rocket to support ground operations
Lacrosse	Highly accurate missile designed to replace artillery

Name	Brief Description
Minuteman	A second generation intercontinental ballistic missile
Shillelagh	A lightweight missile system
Pershing	Designed to replace Redstone
Lobber	Not a weapon but a cargo ballistic missile
Surface-to-under water:	
Weapon Alpha	Anti-submarine rocket
Asroc	Designed for anti-submarine work
Subroc	Advanced tactical missile to be launched from submerged submarines
Surface-to-air:	
Talos	Supersonic missile
Terrier	Anti-aircraft weapon--supersonic
Nike-Ajax	First American surface-to-air missile
Nike-Hercules	Air defense missile with nuclear warhead
Nike-Zeus	Designed for defense against attack by enemy intercontinental ballistic missiles
Bomarc	Supersonic pilotless interceptor --an intermediate range air defense weapon
Redeye	Designed to provide individual troops with defense against low level air attack

Name	Brief Description
Tartar	Supersonic version of an improved Terrier
Hawk	Supplementary weapon to Nike-Ajax and Nike-Hercules, designed primarily for use against low flying aircraft
Air-to-surface:	
Zuni	Designed primarily as air-to-ground rocket for use with Navy fighter and attack aircraft
Bullpup	A tactical missile, relatively inexpensive, yet highly accurate
ALBM	The code designation for a new weapon, the air launched ballistic missile
Hound Dog	Supersonic missile designed to extend capability of manned strategic bombers
Corvus	Supersonic missile using prepackaged liquid rocket engine
Quail	Diversionary missile to divert attention of enemy defenses from bombers
Air-to-air:	
Sidewinder	Defensive weapon with infrared seeking guidance system
Sparrow III	For use with Navy interceptors with radar homing guidance system
Falcon	Rocket fired and guided automatically with radar or heat seeking device

Name	Brief Description
Genie	First air-to-air weapon to be equipped with nuclear warhead
Drones, Targets, and Surveillance:	
SD-2	Army surveillance drone
SD-4	Combat surveillance drone
SD-5	Intelligence-seeking drone
RP-76	Target drone
XQ-4	High speed missile target
Q-2A Firebee	Target drone
P 106 A	Training target missile
XKD2B-1	A Mach 2, liquid rocket propelled expendable target system
KDB-1	Radio-commanded missile target
KDT-1	Low-cost expendable drone
Pogo-Hi	Missile target
Q-5 Kingfisher	Target missile with a speed capability in excess of Mach 2

C. Problem area: What are the purposes of our current missile program and the program of space research?

1. Basic understanding: The role of space research to date has been to add to the knowledge and under-

standing of the earth, the solar system, and the universe.

2. Important information: Space is man's new frontier. There are few remaining geographical explorations to be made on earth.

"There are four major reasons for the surge of interest and activity in space technology on the part of the American public and the United States government" (43:117):

1. The inquisitive characteristics of man compel him to explore, to discover, and to go where no human has gone before.

2. The requirements of a national defense program necessitate the development of space technology to permit the United States to defend itself.

3. The achievements of a successful space program enhance national prestige and create among the people of the world added confidence in American scientific, technological, industrial, and military strength.

4. The accomplishments of space travel develop new opportunities for scientific observation and experiment, which in turn adds to the knowledge and understanding of the earth, the solar system, and the universe.

Thesis 2: Many people have contributed to the progress of aviation and space research. Many ancient myths and legends tell of man's early attempts to fly and his deep-seated interest in flying. Flight developed as a result of

early experimentation with balloons and gliders. Then, in 1903, the first powered airplane flew. It flew only 120 feet and remained in the air only twelve seconds. Yet this 12-second airplane flight was the birth of aviation, the first stone laid in the foundation of the world as it exists today.

History of Aviation

A. Problem area: How has aviation developed and what persons have contributed to aviation's progress?

1. Basic understanding: Modern aviation is the result of man's great desire to fly and the untiring efforts and sacrifices of men who had faith in man's ability to fly.

2. Important information: Man's struggle to conquer air comes from his desire to explore the unknown and untried. The early legends of Daedalus and Icarus, Pegasus, The Magic Carpet, and The Flying Stool make an excellent beginning for a story from Myth to Mach.

Early attempts at flight date back to the 1500's when Leonardo da Vinci made designs for airplanes, constructed a flying machine, but thought that man's muscular power would be adequate to propel him through the air.

The Montgolfier brothers of France, in 1783, filled a large balloon with smoke and sent it into the air. Later they attached a basket to the balloon and sent up a rooster, a lamb, and a duck, the first passengers.

Pilatre de Rozier, also of France, was the first human being to go up in a balloon, in 1783, having received permission from the king to take the place of a convict who had been chosen for the experiment.

Continued experimentation with balloons and gliders by such men as Jacques Charles, Jean-Pierre Blanchard, John Jeffried, Sir George Cayley, Henri Gifford, Otto Lillienthal, Octave Chanute, Percy Pilcher, and Samuel Langley preceded the history-making flight of the first powered aircraft by the Wright brothers, Orville and Wilbur, in 1903.

Later developments came swiftly after the initial success of the Wright brothers. Louis Bleriot crossed the English Channel in 1909.

But it was not until World War I that the practicality of the airplane was recognized. It was then that governments of the world began spending considerable money and time to improve

airplanes for reconnaissance, fighter, and bomber purposes.

At the end of the war, private flying grew in popularity, introducing the miracle of flying to thousands of people.

In 1919, the Atlantic Ocean was spanned by United States Navy airmen in a Curtiss flying boat. In 1922, General "Billy" Mitchell flew at a record speed of 222.9 mph. Members of the United States Army Air Service flew around the world in 1924. In 1926, Commander Richard E. Byrd and Floyd Bennett flew over the North Pole. The next year, Charles Lindbergh made the first non-stop flight from New York to Paris. Byrd and Balchen flew over the South Pole in 1929.

Speed records were attempted and attained by Frank Hawks, Roscoe Turner, Kingsford-Smith, and many others.

Women pilots who helped to set some of the early records included Ruth Nichols, Amelia Earhart, and Jacqueline Cochran.

Around-the-world flying began in 1931 when Wiley Post, with Harold Gatty as navigator, made such a flight in a little more than eight days. Post soloed it alone in seven days two years later.

This record stood until 1938 when Howard Hughes and a crew of four flew the 14,791 miles in somewhat less than four days. In 1949, Captain James Gallagher and the crew of a United States Air Force B-50 flew non-stop around the world in 94 hours and one minute.

Year by year the world speed and distance records steadily improved. As jet-powered aircraft arrived on the scene, all existing records were broken. The honor of being the first man to break the sound barrier goes to an American flying an American-designed and manufactured airplane. On October 14, 1947, Captain Charles (Chuck) Yaeger, in a Bell X-1, flew at a speed of Mach 1.45 (968 mph). On December 12, 1953, he flew at two and a half times the speed of sound. In exactly 50 years to the month, man had developed and refined aircraft to such a degree that speed had progressed from 7 mph to 1,650 mph.

History of Rockets

A. Problem area: How has the use of rockets developed?

1. Basic understanding: Rockets date from the 13th century.

2. Important information: Earliest authentic records show that the Chinese used rockets as early as

1232 against the Mongols during the siege of Kaifung-fu.

The first mention of rockets being used in Europe was in the Chronicle of Cologne in 1258 and again in 1379 when an Italian historian credited the rocket's use in the battle for the Isle of Chiozza.

An account published in the late 18th century refers to the large number of rockets fired during a battle at Paniput, India, and British records of the Battle of Mysore tell of Indian rocket troops.

Up to this period the rocket's primary use had been as a weapon. In 1826, it was used as a life-saving device when four rocket life-line stations were begun on the Isle of Wight in the English Channel.

During the latter part of the 19th century, William Hale, an American, developed a rocket which rotated by offset exhaust nozzles.

The first practical studies of rocket propulsion as a means of attaining space travel speeds came near the end of the 19th century and are usually credited to Konstantin Ziolkowsky, a

Russian mathematics teacher; Herman Ganswindt, a German law student; and Robert Ensnault-Pelterie of France.

The first American contribution to rockets of any importance was made by Dr. Robert H. Goddard, a physicist. On March 16, 1926, he successfully fired the first liquid fuel rocket. It attained an altitude of 184 feet and a speed of 60 mph. He was also the first to fire a rocket that reached a speed faster than the speed of sound.

The research and writings of Herman Oberth, Dr. Walter Hohmann, Max Valier, and Willy Ley established the foundation for German experiments. The first European liquid-fuel rocket was successfully tested in 1931. In 1936, the "Peenemunde Project" was organized, and General Walter Dornberger became the commander of the experimental missile test station.

In the era after World War II, both the United States and Russia profited from the research done by the Germans at Peenemunde and other rocket research centers.

Today there are many missile projects in various stages of development, working on both offensive and defensive weapons, with rocket, turbo-jet, and ram-jet engines.

The guided missile emerged through an evolutionary process which has accelerated rapidly during the last thirty years. The increased activity is due largely to the wealth of information on aerodynamics, propulsion, and guidance which has been secured through development of the airplane.

Thesis 3: Aerospace activities make all people of the world our neighbors. In earlier times man struggled years to reach distant places. Now man can reach the most remote place in the world in a matter of a few hours. World trade, travel, and communication have been changed in the Aerospace Age.

World Trade, Travel, and Communication

A. Problem area: How have foreign trade, travel, and communication increased world understanding?

1. Basic understanding: An understanding of people in other lands, of simple inter-relationships, and of the one-world community created by aerospace activities reduces misunderstandings.

2. Important information: The shrinking of the world through use of the airplane makes all people of the world neighbors, makes possible air trade which benefits us and our neighbors, brings

governments into closer contact with each other, and promotes cultural exchange.

Aviation has changed relationships between countries because oceans, mountains, and arctic climates no longer protect a country from enemy attack.

Aviation has taken the meaning out of the old division of the world into Eastern and Western Hemispheres. People and nations which we used to think of as on the other side of the world are now less than a few hours away by jet--fewer hours away, in many instances, than a visit by car to friends or relatives in a neighboring state.

Aviation has made possible the moving of men and goods great distances in a short time--the shipping of valuable and perishable products to any part of the world in a matter of a few hours. For example, valuable ores containing uranium can be flown from remote wilderness areas of the world to refineries when but a few years ago these areas were inaccessible to man. Fresh flowers are flown daily from Hawaii to world markets. The airplane has helped conquer disease by bringing doctors, nurses, and medical supplies to remote places never before reached by medical science. Such air trade benefits us and all our neighbors.

As aviation shrinks the world, the people of all countries become more concerned with what's happening in other parts of the world. Take, for example, a new neighbor moving next door to you. Before he arrived, you knew nothing of him, his family, his joys, his sorrows, or his needs. When he became your next-door neighbor, you not only got to know him, but to know all the intimate things about him. His problems became your problems, and vice versa. Few misunderstandings develop when one knows and understands one's neighbor. So it is in world communications. Such closeness as is brought about by aviation helps people of all countries express their ideas face to face and brings their governments into closer contact with each other.

With the advent and use of missiles and space satellites, no country is immune from attack, and all countries of the world are placed under constant surveillance.

Aviation makes possible faster world distribution of printed materials, likewise. Air editions of newspapers and magazines printed in the United States can be read in many parts of the world the same day they are printed here.

Attempts have been made, also, to influence the thinking of other people by dropping propaganda materials in other countries from aircraft.

Aircraft and spacecraft are used hourly to increase our knowledge of the world and universe. By means of our space satellites, new information is reported constantly on conditions in outer space. By means of aerial photographs, we are able to survey any part of the earth. Through the use of aircraft we are able to detect underground deposits of mineral wealth and increase our knowledge of weather. Scientific expeditions can be flown to all parts of the world and the knowledge gained shared with all people, as can be the discoveries of new sources of raw materials to benefit mankind.

Aviation promotes cultural exchange among nations of the world as world travel increases. Exchange students and teachers are becoming commonplace today. Such programs aid world understanding. One finds little hostility among people who understand each other's cultures.

B. Problem area: What preparation does the traveler need for greater enjoyment of world travel?

1. Basic understanding: Enjoyment of air travel is dependent upon careful planning and a knowledge of regulations governing air travel.
2. Important information: The use of the airplane has made it possible for many people to visit nearly all points on the globe. If we are to promote better relations between nations and people, we must have preparation for travel through better understanding of the people and countries with which we will be brought into contact.

A careful study of the cultures of other countries, their customs, and languages will help erase the ignorance which has been one of the difficulties the United States has had in establishing good will.

There are many things to learn: the differences in standards of living and conduct, the slower tempo at which things move in many places, the things which are common and similar, and the many problems shared by all nations.

Tourists and business men can do much to strengthen or weaken the feeling of good will toward the United States in other countries.

In air travel, not one but many countries may be entered in a short period of time. This

requires an understanding of the manners and customs prevailing in each place. This also requires more preparation that that possessed by the average tourist of the past, who too often had a tendency to criticize the ways of countries not exactly like his own.

Good manners and courtesy are prerequisites for establishing good relations among people. For example, shaking hands is a common habit among people of the Western countries, while in certain parts of the East it may be a breach of etiquette.

Many customs may seem ridiculous and humorous to the average tourist, but any evidence of humor or undue curiosity can do much to cause resentment on the part of the local people.

Proper behavior in public is important, and observance of local mores and customs does much to establish good feeling toward foreigners. It is important that potential travelers know what places may or may not be visited, whether tips are expected and how much to give, or whether tips are included in the bill, eating habits, common courtesies, manners in public conveyances, patience in waiting turns and standing in line, the position of women in the culture, and the like.

Religious faiths of others must also be respected. Many traditions, such as dances and ceremonials, are sacred to the performers, not a source of entertainment.

In many remote spots such as the islands of the South Pacific or areas formerly removed from the lanes of travel, different customs in dress prevail. The traveler should respect these customs as part of the mores of that civilization--not as a source of curiosity or humor.

Enjoyment of air travel is dependent upon careful planning and a knowledge of the rules and regulations governing air travel. Legal restrictions in the form of passports, visas, birth certificates, health regulations, and customs restrictions, are a few. Others include the services of the United States Consulates and Embassies; travel agencies, such as the American Express; and where to go and what to do if the traveler is separated from his party, is ill, or loses his money or passport.

An understanding of the procedures of air travel will be helpful. Airlines furnish time-tables similar to railroad and bus time-tables. A visit or telephone call made well in advance

of an anticipated trip assures one of getting a ticket.

Practically all countries likely to be places of extensive immigration have laws governing entry.

The time required to get passports and visas and the expense will limit the number of would-be travelers.

Health inspections are required before entrance into many countries, as are such vaccinations as typhoid and smallpox.

Air travelers must learn to travel "light." Baggage is limited, whether travel is continental or intercontinental. The ticket office checks the weight of the passenger and his luggage.

Lastly, enjoyment of travel will be facilitated through anticipation of climatic and physical conditions to be encountered. Knowledge of climate and physical conditions will aid the traveler in his preparation of necessary clothing and equipment.

Language can become a problem. To understand and speak some of the common words, including those used in monetary values, measurements, and other important needs, is necessary.

TABLE I

CONTINUITY CHART OF AEROSPACE STUDY

Thesis 1: Man lives in a continually changing world--a world in which aerospace activities have been and will continue to be important factors.

I. Aerospace Changes

A. Problem area: How are people in the world influenced by changes of the Aerospace Age?

Basic understandings: Aviation has brought about many social, economic, religious, and political changes to the world.

Aerospace activities provide jobs for millions of people.

The airplane has conquered all physical boundaries, since the air is a universal medium reaching every point on the earth's surface.

B. Problem area: Why is it impossible to picture the world in only two dimensions?

Basic understandings: Accuracy in picturing the world in only two dimensions is impossible because the world is a globe.

The Great Circle Route is the shortest route from place to place, but it does not appear as a straight line on most flat maps.

We live in a shrinking world, and our community has expanded until it includes the entire world.

C. Problem area: Why is international control of aerospace activities essential?

Basic understanding: National and international regulation and control of aerospace activities are essential for safety and world peace.

TABLE I (continued)

II. Interplay of Forces that Affect Flight

A. Problem area: What makes an airplane fly?

Basic understanding: Air has certain characteristics which make flight possible.

B. Problem area: What permits an airplane to leave the ground and sustain itself in flight?

Basic understanding: There are four forces working upon an airplane in flight.

The general structure of the airplane makes possible controlled and safe flight.

C. Problem area: What controls permit the pilot to fly his aircraft? What are the names and locations of the major parts of the airplane? What shows the pilot how his aircraft is performing correctly? How does an airplane take off, climb, dive, turn, land, and perform in general?

Basic understanding: Airplanes are constructed to make use of, or to overcome, the forces acting upon them.

III. Aircraft:

A. Problem area: How are aircraft classified?

Basic understanding: Aircraft may be classified according to relative weight or displacement (heavier-than-air and lighter-than-air); provision for propulsion; provision for take-off and landing; according to wing construction; and according to use.

B. Problem area: What are the services of planes?

Basic understanding: Services of aircraft include transportation of people and cargo, defense, protection of natural resources, and emergency

TABLE I (continued)

services. These fall into three main categories: military, commercial, and general aviation.

C. Problem area: How are aircraft identified?

Basic understanding: Airplanes are identified by size, shapes, and parts and their locations; by markings and armament; and are named according to code designations.

D. Problem area: How are airplanes serviced and maintained?

Basic understanding: Special care is given to commercial planes which carry passengers. Safety in the air depends upon the care and precision of maintenance on the ground.

E. Problem area: What will future planes be like?

Basic understanding: Future aircraft will include many different kinds of planes depending on the particular purpose for which they will be used. Changes in design, performance, and propulsion may be made.

IV. Airports:

A. Problem area: What is an airport?

Basic understanding: An airport serves aircraft in all ways.

B. Problem area: Why is airport traffic control necessary?

Basic understanding: Air Traffic control is essential to safe flying.

V. Airways:

A. Problem area: What is an airway?

Basic understanding: Airways are highways of the air.

TABLE I (continued)

B. Problem area: How is flight controlled along the airways?

Basic understanding: Navigation facilities are provided to make airways safe for air transportation.

VI. Spacecraft:

A. Problem area: What are rockets, missiles, and satellite vehicles?

Basic understanding: Rockets operate on the principle of action and reaction, burn a fuel-oxygen mixture, exhaust burning gases created by fuel mixture, and carry their own oxygen.

Basically, a missile is an object thrown at a target, i.e., a weapon.

Satellite vehicles are the rockets used to launch man-made satellites into orbits in space.

B. Problem area: How are missiles classified?

Basic understanding: Missiles are classified according to use.

C. Problem area: What are the purposes of our current missile program and the program of space research?

Basic understanding: The role of space research to date adds to the knowledge and understanding of the earth, the solar system, and the universe.

Thesis 2: Many people have contributed to the progress of aviation and space research.

I. History of Aviation:

Problem area: How has aviation developed and what people have contributed to aviation's progress?

TABLE I (continued)

Basic understanding: Modern aviation is the result of man's great desire to fly and the untiring efforts and sacrifices of men who had faith in man's ability to fly.

II. History of Rockets:

Problem area: How has the use of rockets developed?

Basic understanding: Rockets date from the 13th century.

Thesis 3: Aerospace activities make all people of the world our neighbors.

I. World Trade, Travel, and Communication:

A. Problem area: How have foreign trade, travel, and communication increased world understanding?

Basic understanding: An understanding of people in other lands, of simple inter-relationships and of the one-world community created by aerospace activities reduces misunderstandings.

B. Problem area: What preparation does the traveler need for greater enjoyment of world travel?

Basic understanding: Enjoyment of air travel is dependent upon careful planning and a knowledge of regulations governing air travel.

TABLE II

SUGGESTED ACTIVITIES TO ACCOMPANY AEROSPACE STUDY

Thesis 1: I. Aerospace Changes:

A. Read newspapers, magazines, books, and pamphlets for information concerning social, economic, religious, and political changes brought about by aerospace activities.

Select clippings, pictures, graphs, and maps to be organized for mounting on bulletin boards.

Give oral reports organizing information obtained--illustrated with audio-visual materials.

Collect pictures and arrange bulletin board display or file showing jobs made available by aerospace industries.

Write letters to aircraft manufacturers, the airlines, government agencies, and private organizations which supply free or inexpensive pictures, pamphlets, and packets for aerospace education classes (55:1-20).

B. Make polar map locating the Great Circle routes used today and compare with routes used by other means of transportation.

Demonstrate difference between Great Circle routes and those of other means of transportation in distance.

Demonstrate uses of latitude and longitude.

Use scales on aeronautical charts and maps to compute airline distances as compared to other routes.

TABLE II (continued)

Make graphs and charts showing comparisons in travel time between various means of transportation, increase in world travel in the past 20 years, and number of planes engaged in world travel.

Figure differences in time it would take to travel from point to point by air as compared to other means of transportation.

C. Collect current events illustrating need for national and international control of aerospace activities.

Show filmstrips which are pertinent (See Appendix D for Order Form for those available at Clover Park School District No. 400, Vocational Technical School, Aviation Education Materials Center.):

FS	342	Wings to Understanding
FS	355	Aviation in the Experience Curriculum at the Elementary School Level
FS	395	Enrichment of Subject Matter Fields Through Aviation Education
FS	345	Coast to Coast Geography from the Air

II. Interplay of Forces that Affect Flight:

A. Demonstrate characteristics of air which make flight possible.

Make and fly paper gliders and kites.

B. Make charts and diagrams to show four forces working upon an airplane.

TABLE II (continued)

Show film:

MP 3-5 How an Airplane Flies

Make charts illustrating the parts of plane which make use of, reduce, or overcome these forces.

C. Visit airport to watch the airplanes and to identify parts of plane which control flight.

Visit high school aviation classes in which aviation equipment may be seen.

Make model planes to illustrate principles of plane construction.

Show film:

MP 6 How an Airplane Flies

III. Aircraft:

A-D. Visit airport to observe: kinds of planes, shops where planes are serviced, and identification and markings of planes.

A-B. Select, group, and mount aircraft pictures according to any or all of these areas.

A-E. Find information concerning: lighter-than-air craft, heavier-than-air craft, planes of the future, identification of planes, maintenance of planes, and services of planes.

B. Show filmstrip:

FS 346 Uses of Aircraft

C. Make samples of plane insignia and markings.

C. Organize a "spotter's" club for identification of aircraft.

TABLE II (continued)

D. Show film:

MP 51 Servicing an Airplane

IV. Airports:

A. Visit airport to observe: layout of landing field and buildings; facilities for planes, passengers, and the public.

Show filmstrip:

FS 349 Seeing the Airport

Select pictures of airports and their services.

Construct airport with control tower.

B. Visit a control tower.

Show filmstrip:

FS Traffic

Create rhythmic activities to interpret take-offs and flight instruction at an airport.

V. Airways:

A. Look at various sectional aeronautical charts to study airways.

Continue scrapbook or bulletin board displays of pictures to illustrate these activities.

Make a map locating the airways of the United States.

B. Visit airport to observe: weather bureau, airways communications room, control tower.

TABLE II (continued)

		Interview airways communications personnel to gain information about: gathering weather data, operation of radio facilities, airways traffic control, and airport traffic control. Listen to radio or television for weather forecasts and make a weather graph showing daily temperatures. Prepare a flight plan or flight log. Show filmstrip: FS Airway Aids
VI.	Spacecraft:	
	A.	Select pictures and news clippings concerning topic. Make cut-away sketches of space vehicles.
	B.	Classify pictures of missiles according to use.
	C.	Make chart showing satellites in orbit--interchangeable so that fallen ones may be removed and new ones added. Show purposes of each.
Thesis 2: I.	History of Aviation:	
		Watch television programs concerning aviation history, famous people in aviation, and famous flights. Continue picture collections. Construct models of airplanes in which famous flights were made--from Myth to Mach. Make portraits of famous fliers.

TABLE II (continued)

		Make mural illustrating famous events in the history of aviation.
		Make book reports on biographies of famous people in aviation.
		Make a chart showing speed records of famous flights.
		Report on myths and legends of flight.
		List famous airships, famous planes, and famous people connected with aviation.
		Make a "Who's Who" game about famous people in aerospace activities.
		Learn folk dances of that period of American history in which early events in aviation took place.
	II.	History of Rockets:
		Make a mural depicting the history of rockets from the 13th century use of them by the Chinese to the supersonic ones of today.
		Report on famous people in the development of rockets, missiles, and space vehicles.
Thesis 3:	I.	World Trade, Travel, and Communication:
	A.	Watch television programs which tell about foreign places.
		Continue picture collection for this topic.
		Arrange a collection of interesting arts and crafts from foreign countries.

TABLE II (continued)

Write letters to airline companies for a schedule, time table, or travel folders.

Make a travel display with original pictures or commercial pictures from travel folders or magazines.

Make maps to show an imaginary or real air trip showing airlines used, route, and time involved.

Share personal travel experiences in other countries.

Tell or read current events concerning happenings in foreign countries.

Participate in folk dances of people in other lands.

Show filmstrips and film:

FS	344	World Trade in the Air Age
FS		Aviation and World Understanding
MP	9	Air Power is Peace Power

B. Visit an airline terminal to observe the procedures involved in air travel: the purchase of tickets, weighing-in of passengers and baggage, announcement of arrival or departure of planes, paging of passengers over loudspeaker, outgoing passengers boarding the plane, and the incoming passengers retrieving their baggage.

Invite members of the community to tell of air travels to distant places.

TABLE III

SUGGESTED REFERENCES FOR AEROSPACE STUDY

Title	Author and/or Publisher
Aviation and Space Technology	Institute of Aviation, University of Illinois, Urbana, Illinois, 1959.
Aviation Education Bibliography and Resources	California Aviation Education Association, 1959.
Aviation Education Bibliography (Elementary School) Third Edition	National Aviation Education Council, 1959.
Book of Knowledge	Grolier Society, Inc., 1959.
Britannica Junior	Encyclopaedia Britannica, Inc., 1959.
Childcraft	Field Enterprises Educational Corporation, 1954.
Civil Air Patrol Pamphlets	Harold E. Mehrens, Civil Air Patrol, 1955-1956.
Compton's Pictured Encyclopedia	F. E. Compton and Company, 1959.
Demonstration Aids for Aviation Education	Civil Air Patrol, 1957.
Missiles, from Concept to Countdown	Aircraft Industries Association.
Our Wonderful World	Spencer Press, Inc., 1958.
Pictures, Pamphlets and Packets for Air/Space Age Education. Second Edition	National Aviation Education Council, 1959.

TABLE III (continued)

Title	Author and/or Publisher
Rocketry, Space Exploration, and Aviation Education	California Aviation Education Association, 1959.
The Arithmetic of Flying	National Aviation Education Council, 1959.
United States Aircraft, Missiles, and Spacecraft	National Aviation Education Council, 1960.
World Book Encyclopedia	Field Enterprises Educational Corporation, 1959.

IV. SUMMARY

The teachers' guide to aerospace education contained in this chapter compiled problem areas to undertake and some basic understandings which may develop in three major concept areas of an aerospace program for the sixth grade.

Important information, suggested activities, and related references which would aid in conducting such a program were included, as were some suggested evaluative instruments.

Criteria for selection and organization of the materials were enumerated. Likewise, suggested techniques for organization of the study and teacher-student responsibilities in group work were defined.

A continuity chart (Table I) outlined in brief the three major concept theses areas, problem areas, and basic understandings which were covered in the guide. This was included as an aid to teacher lesson planning.

Suggested activities or experiences to accompany each of the problem areas were given in Table II.

Table III listed suggested references which had proved helpful.

CHAPTER IV

EVALUATION OF AN AEROSPACE PROGRAM IN A SIXTH GRADE

This chapter will present the methods and materials employed to evaluate the acceptance and use of aerospace information and material in a sixth grade classroom and will give a summary of the evaluation.

I. THE METHODS EMPLOYED AND MATERIALS USED

To fulfill the stated purpose of this study, aerospace information and material were integrated into the existing curriculum of a sixth grade class at Tyee Park Elementary School, Clover Park School District No. 400, Tacoma, Washington, during the school year 1959-1960. The materials and information were chosen from those outlined in the "Teachers' Guide to Aerospace Education," which became a part of this study, included in Chapter III.

Criteria for selection were: an indicated interest in and/or questions asked by any of the thirty-one students in the class, and availability of resources.

A pupil questionnaire (see Appendix A) was used to determine the problem areas to be undertaken in the study.

The problem areas to be undertaken were selected on the basis of questions asked by the students. A summary of the types of questions asked was presented in Table IV of this chapter.

The students' questions were listed in the summary in the order of frequency of mention. Similar questions were grouped together to shorten the summary and make it more meaningful.

In addition to administration of the pupils' questionnaires to establish the problem areas to be undertaken in the study, a survey was made of previous aviation experiences to formulate a basis for sharing experiences. For this survey, the second pupil questionnaire (see Appendix A) was used.

A summary of the personal aviation experiences of the children was made in Table V. Similar experiences were grouped for ease in interpretation, and items were listed in the table in order, according to the number of students sharing like or similar experiences.

Upon completion of the program in the classroom, an evaluation of the value or lack of value of such a program was conducted, employing a teacher's evaluation check sheet, a student's evaluation check sheet, and a parent's opinionnaire (see Appendix B).

TABLE IV

STUDENTS' INTERESTS IN AEROSPACE ACTIVITIES

Question	Frequency of Mention
How does an airplane fly? (How fast does it go or how does it go so fast?)	30
How do you recognize (identify) the different kinds of planes? (What kind of airplane is it?)	20
How are airplanes useful? (Why do we have planes, missiles, and satellites? Why are they up there?)	12
What are the parts of an airplane for? (What do they do? How do they work? How does a pilot control a plane?)	11
How do you read and use the instruments for planes and rockets? (Why do they have instruments? What are the instruments? What are they for?)	11
What launches a missile? (What kind of fuel do they use? How can they orbit the earth? How can they go so far?)	11
What are the parts of a plane?	9
What do airplanes carry and/or where do they go? (How many people can they carry?)	7
From what kinds of material is a plane or rocket made?	5
Who are some of the famous people involved with planes and/or space research?	4
Who manufactures planes? (How are they manufactured?	4

TABLE IV (continued)

What are the sizes of planes? (Why are planes the size they are?)	3
What kinds of planes fly around here (McChord Air Force Base and Tacoma)?	2
When will we reach the moon? (Why did we miss the moon?)	2
What are the names of missiles? (How do you tell missiles apart?)	2
What is the inside of a plane like?	2
What is the difference between private, military, and commercial planes?	2
How does the United States compare with Russia in rockets and missiles? (Will we ever catch up with the Russians?)	2
What is the size of an airplane crew?	1
How did the Wright brothers' plane fly?	1
What are missiles used for?	1
How are missiles guided?	1
How does a pressure suit help a pilot?	1
Why are airplane wings shaped as they are?	1
What are some of the satellites we have in space?	1
How do they train the people who work on airplanes?	1
I'd like to learn about an airport.	1

TABLE V

STUDENTS' PREVIOUS EXPERIENCES IN AEROSPACE ACTIVITIES

Type of Experience	Number of Students Sharing Experience
Flights by commercial airlines. (A wide variety of flights was indicated: trips to Hawaii, Palm Springs, Victoria, Texas, Washington, D. C., and others.)	18
Visits to SeaTac Airport to see relatives or friends arrive or leave on a flight.	10
Visits to Boeing Field, Yakima Airport, Gray Field, Geiger Field, and other airports, including visits to control towers, tours of airline offices and other buildings at airports, or to go through the airplanes.	10
Visits to McChord Air Force Base (or other bases) to see relatives or friends arrive or leave on flights; to see the bases, planes, or air shows.	9
Flights in private airplanes (including seaplanes).	9
Flights from overseas bases to the United States.	6
Flights to overseas bases from the United States to Germany, Japan, England, or others.	4
Lived on or near Air Force bases most of life because father was in the United States Air Force.	4
No previous aviation experience or "never flown."	4
Father teaches aviation or air science classes.	2

II. THE EVALUATION

Upon completion of the aerospace program in the sixth grade classroom, an evaluation of the value or lack of value of such a program was conducted by using a teacher and a pupil evaluation check sheet, supplemented by a parents' opinionnaire (see Appendix B).

The evaluation, in each instance, rated seven items of accomplishment for each child, in behavioral terms, as follows:

1. Work in the unit met the main objectives, as shown by knowledge of aerospace activities, by appreciation and respect for the work and achievements of the pioneers in the field, and by understanding and appreciation of the ideas and opinions of others in order to live peacefully in a world community.
2. Growth in responsibility was shown by the way assignments were carried out completely and independently.
3. Improvement in class participation was shown by the contributions of interesting and related information and materials from home and from research done.

4. Growth in reading was shown by use of the library and reference materials.
5. Vocabulary growth was shown by understanding and use of the new words in discussions.
6. Growth in ability to think critically was shown by evaluation of materials used as to timeliness, accuracy, relevance, and bias.
7. Gain in positive knowledge of the Aerospace Age was shown by understanding of air and space travel in relation to his own future, and by improved attitudes toward their importance.

The teacher and the children used a five-point rating scale for each of the seven items: (1) superior, (2) above average, (3) average or satisfactory, (4) below average, and (5) none.

The parent, however, was asked to rate each item on a three-point rating scale: (1) good, (2) satisfactory, and (3) poor.

This was done on the assumption that it would be difficult for the parent to evaluate to as fine a degree of excellence as the teacher or child, since the basis for his opinion was, necessarily, confined to obvious behavior of his child alone, out of the school situation, with no other means of analysis or comparison available to him.

To reconcile the difference in the rating scales, the ratings labeled superior and above average on the five-point scale were tabulated as "good," and those labeled below average and none were tabulated as "poor" to correspond to the three-point scale used by the parents.

In addition to rating the seven-item check sheet, the parent was invited to make additional comments relative to the value or lack of value of such a study in the sixth grade. This was done with the hope that weaknesses within the program could be pointed out and reported in this study. Such comments as were made have been summarized in Table VI.

The opinionnaires were sent to the parents of the thirty-one students. Thirty of them (or 96.22 per cent) were returned. All thirty-one of the teacher and pupil evaluation check sheets, however, were included in the results.

The tabulated results of the evaluations revealed much that was interesting and helpful to this study.

In reporting the results of the evaluations, reference was made to the various items on the evaluation sheets by the numbers one through seven and by a brief description of the item referred to. This was possible because the items were as closely identical as possible on each form.

TABLE VI

TEACHER, STUDENT, AND PARENT EVALUATION

OF AN AEROSPACE PROGRAM

IN THE SIXTH GRADE

Item 1: Work met main objectives as shown by knowledge of aerospace activities, by appreciation and respect for work and achievements of pioneers in the field, and by understanding and appreciation of ideas and opinions of others in order to live peacefully in a world community.

GROUP	GOOD	SATISFACTORY	POOR
Teacher	48.4 %	41.9 %	9.7 %
Children . . .	48.4	51.6	0.0
Parent[1]	33.33	63.33	0.0

Item 2: Growth in responsibility was shown by the way assignments were carried out completely and independently.

GROUP	GOOD	SATISFACTORY	POOR
Teacher	51.6 %	38.7 %	9.7 %
Children . . .	58.1	38.7	3.2
Parent[2]	50.0	46.67	0.0

[1]One parent said: He "couldn't determine" results on this item.

[2]One parent said: I "can't answer" this item.

TABLE VI (continued)

Item 3: Improvement in class participation was shown by the contributions of interesting and related information and materials from home and from research done.

GROUP	GOOD	SATISFACTORY	POOR
Teacher	64.5 %	29.0 %	6.5 %
Children . . .	61.3	35.5	3.2
Parent	70.0	30.0	0.0

Item 4: Growth in reading was shown by use of library and reference materials.

GROUP	GOOD	SATISFACTORY	POOR
Teacher	32.3 %	48.4 %	19.3 %
Children . . .	51.6	41.9	6.5
Parent	26.7	70.0	3.3

Item 5: Vocabulary growth was shown by understanding and use of the new words in discussions.

GROUP	GOOD	SATISFACTORY	POOR
Teacher	77.4 %	22.6 %	0.0 %
Children . . .	77.4	22.6	0.0
Parent	30.0	70.0	0.0

TABLE VI (continued)

Item 6: Growth in ability to think critically was shown by evaluation of materials used as to timeliness, accuracy, relevance, and bias.

GROUP	GOOD	SATISFACTORY	POOR
Teacher	25.8 %	58.1 %	16.1 %
Children . . .	48.4	45.1	6.5
Parent[1]	23.3	70.0	3.3

Item 7: Gain in positive knowledge of the Aerospace Age was shown by understanding of air and space travel in relation to his own future, and by improved attitudes toward their importance.

GROUP	GOOD	SATISFACTORY	POOR
Teacher	51.6 %	48.4 %	0.0 %
Children . . .	71.0	29.0	0.0
Parent[2]	43.3	53.3	0.0

[1]One parent said: He "could not determine if knowledge was gained" in this area.

[2]Ibid.

In the comparison of Item 1 (the manner in which main objectives were met), the teacher and the children showed a higher percentage of "good" ratings than did the parents--a difference of 15.06 per cent. However, the parents indicated no "poor" results, whereas the teacher rated nearly ten per cent "poor" in this category.

The comparison of Item 2 (growth in responsibility) showed that the children rated themselves higher than did the teacher or parents, although all three groups rated fifty per cent or more with a "good" rating. Again, the parents rated more in the satisfactory group than did the teacher or the children, and the teacher indicated that 9.7 per cent showed "poor" growth in this area.

Improvement in class participation (Item 3) was rated to indicate close agreement among parents, teacher, and children. All three groups rated a high percentage of "good" results in this area, ranging from 61 per cent on the part of the children to 70 per cent by the parents. The parents rated improvement in this area higher than did either the teacher or the children, and again they showed no "poor" rating. The teacher, on the other hand, rated 6.5 per cent "poor."

Growth in reading (Item 4) was rated as one of the areas in which, it was felt, less improvement was made in the opinion of both parents and teacher. However, the children

rated 51.6 per cent "good" on this item. The teacher's evaluation of 19.3 per cent "poor" in this category was the lowest of all items evaluated. This, apparently, was an area in which greater emphasis should have been placed.

The greatest variance of opinion in the entire evaluation was made on the ratings of Item 5, vocabulary growth. The parent rating showed only 30 per cent of the children as having made "good" improvement in vocabulary as compared to 77.4 per cent on the part of both teacher and children. This differential of 47.4 per cent was significant.

Perhaps there was little opportunity for the child to discuss aerospace topics with the parents at home (as was being done at school), in which event, the parent would be less aware of any vocabulary growth; or perhaps the greater emphasis on aerospace discussions at school had made the teacher and the children overly aware of vocabulary growth.

On Item 6 (improvement in ability to think critically), the children's ratings were, again, much higher than were the ratings of the parents and the teacher. In fact, there was close agreement between the parents and the teacher, except in the "poor" ratings wherein the teacher rated 16 per cent "poor" as compared to only 3.3 per cent on the part of the parents.

According to the children's evaluation of themselves on Item 7 (gain in positive knowledge of the Aerospace Age),

their gain was considerably higher than was indicated by the teacher or the parents. There was a deviation of almost 20 per cent between the children's ratings and that of the teacher, and almost 28 per cent between their rating and that of the parents.

The ratings on Item 7 were the second instance in which all three groups agreed that no "poor" ratings be given.

One parent stated, however, that he "could not determine if knowledge was gained" in this area; however "he (the son) had learned some basic airplane parts and functions as well as principles of operation of basic aircraft." This comment was not tabulated in any rating group.

Perhaps one of the most significant results of this comparison was the fact that parents rated only 3.3 per cent "poor" accomplishment on each of two items--growth in reading and growth in ability to think critically. All of their other ratings were either "satisfactory" or "good." (An interesting comparison could likewise be made with similar ratings of the other subject-matter areas being taught in the sixth grade at the present time).

Significant also was the fact that on all but two of the items (the two where no one marked "poor" results), the teacher's ratings in the "poor" classification were always greater than the ratings of the parents or the students.

This could have many implications. It could have been evidence of a more definite and concrete method of evaluation.

The children, generally, rated themselves higher than did either the teacher or parent. The one exception was in the area of class participation.

An interesting comparison was made in the areas receiving the highest ratings by each of the groups. The greatest percentage of "high" ratings by the parents was in the area of class participation. This was, perhaps, more apparent at home since much of the material brought for the study came directly from or were made at home--models, pictures, and clippings, and home life was directly affected by these contributions. The morning newspaper and current magazines minus their aerospace articles and pictures, weekly allowances being spent for model air and space craft, and experimentations at home with flying models to prepare for demonstrations at school often involved family participation.

The students and the teacher, on the other hand, indicated the greatest improvement in the area of vocabulary growth. This growth was apparent in classroom discussions, and its importance in relation to understanding the topics being discussed was indelibly impressed upon both groups. This would have been less apparent to the parents who were not directly involved.

When invited to make additional comments relative to the value or lack of value of such a study in the sixth grade, thirteen of the parents responded with comments, while seventeen completed the evaluation check sheet with no additional comment at all.

Since cooperative planning between the school and the home on issues concerning the welfare of the child can, in some instances, lead to improvement in instruction, this communication between parent and teacher was planned to provide an opportunity for joint evaluation of the aerospace program.

Many of the comments from parents were well-thought-out and beneficial, indicating careful consideration on their parts. All were considered to be just. All deserve consideration.

The parents' comments were summarized in Table VII and made a part of this chapter. If a child's name was mentioned in a comment, it was omitted in the summary and was indicated by a blank space. The comments were taken from the opinionnaires which had been arranged in alphabetical order, and those with comments were numbered from one to thirteen to correspond to the items in Table VII.

TABLE VII

PARENTS' COMMENTS ON AEROSPACE PROGRAM

IN THE SIXTH GRADE

1. From my standpoint, I felt the unit was too long, however I don't know the extent of the subject matter covered . . . . At home we have been more concerned with . . . reading, writing, spelling, arithmetic, and English.

2. _____ has certainly been interested in the subject and has become acutely aware of air and space things. I believe his deep interest in the subject was accentuated by your own interest and pursuit of the subject . . . .

3. I wonder if there couldn't be a subject that would be more interesting to the girls in the class.

4. While such units of study have certain value, in this instance,--it seems that too much time was spent in identification of current aircraft and . . . on rapidly changing subjects which will soon be obsolete. It would appear in _____'s position . . . drill in problem solving and further development of the basic tools of learning would have been more beneficial.

5. Perhaps as time goes on the value of what _____ learned will show up. It is certainly a timely subject. If one of our boys had had the same opportunity in the sixth grade, I know (he) would have gotten a lot more out of it than she has.

6. I welcome the opportunity to offer our thoughts on the aerospace unit recently given in your class. The outlined objectives read in a masterful manner on paper but were bogged down in reality.

To begin with, the pressure placed on each pupil during the major part of the year by half-day attendance was reflected in their very tense approach to each subject. The very necessary periods of individual

TABLE VII (continued)

instruction were not available. The aerospace unit, with its much too complex research, provoked the same problem. In other words, it was given to the extent of complete pushing into details of little value to a sixth grader. This is a subject more for 8th or 9th (grade). Our students are desperately in need of help and background work preparatory for junior high.

If this is a test for future subject planning, then I say offer aerospace in a brief and less time-consuming way.

You are definitely right insofar as your objectives read and all children need this type of learning; however, brief it down and concentrate on making yourself more available for personal help on all other subjects.

7. _____ has been with us such a short time and I have no way of knowing of his previous interests and responsibilities. I can say that he has definitely shown an interest and knowledge of what he has been doing. Also, his work has been done entirely by himself, finding the material for it, etc.

It would seem to me a worthwhile project to continue. (Grandmother)

8. _____ appears to have a great interest in aviation, even to an ambition to be a pilot, but I hope all this doesn't detract from arithmetic which to me is more important.

9. I'm sure this subject is not necessary for a child to advance to the seventh grade. I can imagine the boys enjoyed the subject much more than the girls.

10. The results were not outstanding in _____'s case because I think the study of airplanes is rather of more interest to boys than girls. This is just my opinion and _____'s--we could be wrong, however.

TABLE VII (continued)

11. _____ has certainly shown lots of improvement in interest and organization of his work and time in the last few weeks. Whether this is entirely due to this unit of study would be hard to say. However, he has found that organizing the study time and working hard for the prescribed time produces the best results. He has found a satisfaction in doing his work with a greater degree of excellence. I cannot say this has carried into enthusiasm for class participation, however. Any kind of group activity is still very hard for _____ to approach. We do appreciate the progress he has made this year and do hope that we can keep it on the upward swing.

12. _____ has always been interested in air and space and judging from my magazines minus their airplane pictures, he seems to take even more interest this year--and of course since his teacher is a pilot, the subject is even more personal to him. Thank you . . . for making it so interesting for him--but how can we the parents keep up to him?

13. Thank you for the opportunity.

    1. I believe the booklet could have been better organized in keeping with the objectives.

    2. Fifty per cent less material could have accomplished the same result--better distribution on material on all of the objectives--better use of library.

    3. Objective three should have been enlarged upon showing that travel by air brings the remote within reach and understanding.

III. SUMMARY

Through the use of pupil questionnaires, the students in a sixth grade class at Tyee Park Elementary School, Clover Park School District No. 400, Tacoma, Washington, were asked to indicate their interests in an aerospace study. These interests became the basis for selection of the problem areas to be undertaken in the study.

A second pupil questionnaire was administered to determine previous aerospace activities in which the students had been involved, as a basis for formulating the sharing of individual experiences.

Upon completion of the aerospace program in the classroom, a teacher, student, and parent evaluation were made relative to the outcomes of the study as compared to the stated objectives.

On the basis of the results of these evaluations, limited as they were, one could conclude that most of the persons involved in the evaluation were of the opinion that the objectives of the aerospace study were met satisfactorily or well.

In reference to the comments returned by the parents on the opinionnaires, some were definitely opposed to this type of study being continued in the sixth grade. Some were outspokenly in favor of continuing such a program, and some

were indecisive to the point that it was hard to interpret the comment one way or the other. All thirteen of the comments were helpful in planning future studies of this nature. Seventeen of the opinionnaires were returned with no additional comments at all.

Those parents who opposed the continuation of such a study seemed greatly concerned lest the other subjects in the grade were being neglected with the introduction of the aerospace information and material, that the research done was much too complex, that this type of study was not interesting to girls, that such a study was not necessary for promotion into junior high school, and that too much time had been devoted to all or parts of the study.

Those parents in favor of continuing the program seemed, generally, to base their opinions on the fact that the interest aroused within the student could have considerable worth, that this was a timely subject, that this would be a worthwhile project to continue, and that, in some instances, they (the parents) appreciated the opportunity to participate in such an evaluation.

CHAPTER V

SUMMARY AND CONCLUSIONS

I. THE LITERATURE

Much of the literature--dealing with the changes brought about by the rapid technological advances in the fields of aviation and space research in the past fifty-seven years and the effects they have wrought upon the social, economic, and political traditions of modern civilization and upon the nature of national and international relationships--was concerned with the demands being placed upon American society to meet the challenge of the Aerospace Age.

Considerable attention was given to the role aircraft and spacecraft has come to play in world affairs, emphasizing the dangers resulting from failure to make appropriate application of and adjustments to the discoveries of the times.

Writers stressed the urgency of providing an opportunity and the necessary guidance for the youth of today to develop an appreciation and awareness of the potential of this giant--air and space technology; they also stressed that youth be given an opportunity to evaluate his own position in relationship to it.

Emphasis was placed, also, on the fact that we cannot sit complacently by assuming that young men and women will choose careers in line with their maximum potential, directed toward meeting the challenges necessary for social, economic, and political survival.

It was pointed out that the cost of adequately educating youth to meet these challenges, when compared to the cost of indifference or intolerance, would be pitifully small.

Studies conducted to determine ways of adjusting the schools' program to the Aerospace Age showed that aerospace education, because it is a high interest center, could be a means of causing more learning in the usual subject-matter areas; that it was not a matter of choosing between aerospace education and other subject matter, but that it was possible to weave aerospace information and material into the existing curriculum so that it was possible to do both and to do them better because of doing them together.

It was recognized that in aerospace education, the youngsters might have greater knowledge of some particular phases than the teacher.

With this in mind, a teachers' guide to aerospace education was prepared. The guide outlined three major concept areas of aerospace activities and implications, listing suggested problem areas, basic understandings, important information, suggested activities, and suggested

references to be used as a resource for integrating aerospace education in the curriculum of the sixth grade.

II. THE TEACHERS' GUIDE

The purpose of the teachers' guide was to provide a ready source of aerospace information and material to which teacher and children alike could turn for help and direction in initiating, conducting, culminating, and evaluating an aerospace program in the existing curriculum of the sixth grade.

Criteria for selection and organization of the material were (1) the significance of the field of aerospace activity to youth, (2) adaptability of material into the existing framework of the curriculum, (3) the children's development, (4) availability of materials, (5) contributions of material to the study, and (6) facility of use.

The guide was designed to be suggestive rather than exhaustive, serving only as a stimulus to greater things.

Possible obstacles to the use of such a program in the schools were enumerated. Solutions were suggested.

Means of organizing the study, employing the direct-experience technique, were given, outlining both the children's and teacher's responsibilities in such a program. Likewise, evaluative instruments were proposed.

Suggested areas to explore were grouped into three major concept thesis areas: (1) Man lives in a continually changing world, (2) Many people have contributed to the progress of aviation and space research, and (3) Aviation makes all people of the world our neighbors.

Within the first of these thesis areas, pertinent topics were developed: I. aerospace changes, II. interplay of forces that affect flight, III. aircraft, IV. airports, V. airways, and VI. spacecraft.

The second of the major concept areas provided information and materials concerning: I. the history of aviation, and II. the history of rockets.

The third and last of the concept areas involved the social, economic, and political implications of international relationships in development of the topic: World trade, travel, and communication.

To evaluate the results of such a program, a study was made of the use of such materials during the school year 1959 and 1960 in a sixth grade class in Tyee Park Elementary School, Clover Park School District No. 400, Tacoma, Washington.

III. THE EVALUATION

To fulfill the stated purpose of this study, aerospace information and material were integrated into the existing

curriculum of a sixth grade class at Tyee Park Elementary School. The information and materials used were suggested by and outlined in the "Teachers' Guide to Aerospace Education" contained herein, and selected on the basis of students' interests and availability of resources.

Upon completion of the program in the classroom, an evaluation of the value or lack of value of such a program was conducted, employing a teacher evaluation check sheet, a student evaluation check sheet, and a parent's opinionnaire.

The evaluation rated seven items of accomplishment, stated objectives of the program, for each individual child.

In addition to rating the seven-item check sheet, parents were invited to make additional comments relative to the value or lack of value, in their opinions, of such a study in the sixth grade.

The children, generally, rated themselves higher in accomplishment, in the evaluation process, than did either the teacher or the parents.

The responses to the evaluation indicated that most of the persons involved in the evaluation felt that the objectives of the aerospace study were met satisfactorily or well.

In reference to the comments returned by the parents, some were definitely in opposition to the study being continued in the sixth grade, some were outspokenly in favor of continuing such a program, and some were indecisive.

Those persons opposed to continuation of such a program seemed greatly concerned lest the other subject-matter areas were neglected, that the research done was too complex, that such a study was not interesting to girls, that it was not necessary for promotion to junior high school, or that too much time was devoted to all or parts of the study.

Those persons who favored continuation of the program seemed to base their opinions on the fact that the interest aroused could have considerable worth, and that this was a timely subject or a worthwhile project to continue.

IV. CONCLUSIONS AND RECOMMENDATIONS

This study attempted to show that, with proper selection, revision, and control of materials used, the integration of aerospace education into the existing curriculum of the sixth grade could have value in enriching the classroom program as one means of meeting some of the broad objectives of a child's education. By using these new materials, in which a keen interest exists, the child could be inspired to a better understanding of the contemporary world, to improve attitudes, to strengthen and expand existing skills, to develop critical thinking concerning aerospace transportation and communication and their implications for his future, to understand that aerospace activities and research will

affect each person because they affect the way all people live and work, and that they have greatly influenced the nature of our relationships with other nations.

However, this type of program could not be considered a panacea for all educational ills. It would be unrealistic, both in terms of a child's educational needs and a teacher's utilization of the materials, to assume that any one educational device would meet the broad objectives of the child's education. It is only through the application of all known techniques of teaching and learning that a child's educational needs can be met.

The aerospace education program could be considered only what it is--one means of enrichment and inspiration to learning.

For the betterment of an aerospace program, it is recommended that research be conducted to determine the degree and direction of change in accomplishment in the so-called basic subject-matter areas brought about by the inclusion of aerospace information and materials in the classroom.

It is recommended, for this purpose, that control groups of comparable abilities be established and the study conducted over a period of time long enough to establish conclusive results.

It is further recommended that future use of the "Teachers' Guide to Aerospace Education" be made with great care in selection of problem areas, to confine the study to those areas coincident with the maturity and development of the students involved, that the problem areas selected coincide with the expressed interests of the students, that close attention be given to correlation of materials with existing subject-matter areas, and that the time devoted to the study be reasonably limited.

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APPENDICES

APPENDIX A

PUPIL QUESTIONNAIRE

Name_____Age_____Date_____Grade_____

DIRECTIONS: Please put your name, age, grade, and the date on the line above.

In order to know what your own interests are about air and space travel and research, would you please write any questions you may have about them. Just any questions will do, as long as they are something about which you really want to learn.

We won't be able to answer all your questions, perhaps, because we may not be able to find the answers. But we will TRY to find the answers together. All that is wanted now is your list of questions. If you do not know how to spell a word, or if you do not understand what you are to do, raise your hand and I shall try to help you.

To help you begin, here is something to think about: When you see an airplane in the air, what is it you want to know about it?

1.

2.

3.

4.

5.

APPENDIX A

PUPIL QUESTIONNAIRE

Name_____Age_____Date_____Grade_____

DIRECTIONS: Please put your name, age, grade, and date on the line above.

In order to know what aviation experiences you have had in your lifetime (if any) before we begin this study, would you please write a brief account of it (them) below? Be sure to include such things as where it was, when it was, and why the experience occurred, and how old you were at the time.

APPENDIX B

PUPIL SELF-EVALUATION

Name_____ Date_____

---

1. My work in the unit met the main objectives as shown by my knowledge of aerospace activities, by my appreciation and respect for the work and achievements of the pioneers in the field, and by my understanding and appreciation of the ideas and opinions of others in order to live peacefully in a world community. . . . . _____

2. I grew in responsibility as shown by the way assignments were carried out completely and independently. . . . . _____

3. I showed improvement in class participation as shown by the contributions of interesting and related information and materials from home and from research done. (Models, clippings, pictures, books, and pamphlets.). . _____

4. I showed growth in reading as shown by my use of library and reference materials . . . . _____

5. I showed vocabulary growth as shown by my understanding and use of the new words in discussions . . . . . _____

6. I grew in ability to think critically as shown by evaluation of materials used as to timeliness, accuracy, relevance, and bias . . . . . _____

7. I gained positive knowledge of the Aerospace Age as shown by my understanding of air and space travel in relation to my own future, and by improved attitudes toward their importance. . . . . _____

APPENDIX B

TEACHER EVALUATION CHECK SHEET

Name_____ Date_____

---

1. Pupil's work in unit met main objectives as evidenced by apparent understanding. . . . . _____

2. Pupil grew in responsibility as evidenced by the way assignments were carried out completely and independently. . . . . _____

3. Pupil showed improvement in class participation as evidenced by contributions of interesting and related information and materials from home and from research done. (Models, clippings, pictures, books, and pamphlets.) . . . . . _____

4. Pupil showed growth in reading as evidenced by use of library and reference materials . . . . . _____

5. Pupil showed vocabulary growth as evidenced by understanding and use of new words in discussing the new ideas. . . . . _____

6. Pupil grew in ability to think critically as evidenced by evaluation of materials used as to timeliness, accuracy, relevance, and bias. . . . . _____

7. Pupil gained positive knowledge of the Aerospace Age in which he lives as evidenced by an understanding of the implications of air and space travel and research in relation to his own future, and by improved attitudes toward their importance . . . . . _____

APPENDIX B

PARENTS' OPINIONNAIRE

FROM: Edith M. Jackson

DATE: June 6, 1960

Your child has taken part in an aerospace unit recently, and I ask for your cooperation in an evaluation of the study.

It is my hope that we may better meet some of the objectives of a child's education, namely, a better understanding of the complex world in which he lives, his rights and corresponding responsibilities therein, improved attitudes, and strengthened skills, by the acceptance and use of study units which are of great interest to the child.

By way of explanation, a unit of study is an organized body of subject matter and activities presented in such a way as to facilitate learning and teaching.

The subject matter of the aerospace unit was, in my opinion, so organized as to be readily grasped by the pupils because it was related to something they knew about or to something which seemed important and interesting to them.

The activities were designed to give the pupils actual experiences in democratic living, making learning an active, vital process. Numerous situations required improved ways of behaving, such as working in groups, assuming responsibility, tackling problems, analyzing and thinking problems through to a solution, and acquiring social experience which can be applied to later situations.

The main objectives emphasized were:

1. To understand that man lives in a continually changing world in which aerospace activities have been and will continue to be important factors. Therefore, we need to understand something of the history of man's fight to fly and develop a general knowledge of the simple scientific principles of aviation and space research and the services they render society.

2. To understand that many people have contributed and are now contributing to the progress of aerospace activities. Therefore, we need to develop an appreciation and respect for the work and achievements of these pioneers.

3. To understand that aerospace activities make all peoples of the world our neighbors. Therefore, we need to develop an understanding and appreciation of the ideas and opinions of others in order to live peacefully in a world community.

To help in this evaluation, would you please mark the attached check sheet, rating the outcomes according to the rating scale. (You may want to discuss these topics with your child before completing the check sheet.)

This evaluation in no way affects your child's grade in any class. It is, rather, part of an evaluation of the usefulness of the aerospace unit itself.

If you would care to make any additional comments, I would appreciate any opinions relative to the value or lack of value of such a study. For additional comments, use the back of the check sheet, please.

Thank you for your cooperation.

_____

Teacher

RATING SCALE:

GOOD . . . . . Results were more than satisfactory.
SATISFACTORY . . Results were satisfactory.
POOR . . . . . Results were poor.

	GOOD	SATISFACTORY	POOR
1. Pupil's work in the unit met the main objectives outlined on page 2 as evidenced by his apparent understanding of them.			
2. Pupil grew in responsibility as evidenced by the way assignments were carried out completely and independently.			
3. Pupil showed improvement in class participation as evidenced by contributions of interesting and related information and materials from home.			
4. Pupil showed growth in reading as evidenced by use of library and available reference materials.			
5. Pupil showed vocabulary growth as evidenced by understanding and use of new words in discussing these new ideas.			
6. Pupil grew in ability to think critically as evidenced by evaluation of materials as to timeliness, accuracy, relevance, and bias.			
7. Pupil gained positive knowledge of the Aerospace Age in which he lives as evidenced by an understanding of the implications of air and space travel and research in relation to his own future.			

APPENDIX C

FIELD TRIP REPORT

Name_____Date_____

UNIT BEING STUDIED:_____

Subject of Field Trip:_____

Purpose:_____

Place:_____

People in charge:_____

_____

_____

This is what I learned:

This is how it helps our study:

APPENDIX D

CLOVER PARK SCHOOL DISTRICT NO. 400
Vocational Technical School
Aviation Education Materials Center
5214 Steilacoom Boulevard S. W.
Tacoma 99, Washington

Phone: JUniper 8-5261, Extension 333

To order graded Aviation Education Materials from our library, please fill in the enclosed form and return it to the above address.

Date_____

Teacher_____

School_____

Packet for Grade_____When needed_____

Films: MP#_____

MP#_____

MP#_____

Filmstrips: FS#_____

FS#_____

FS#_____

Other, please specify:_____

_____